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1. EXECUTIVE SUMMARY

The dissemination and communication activities in the HEARTEN project are carried out within WP2 - Dissemination and Exploitation. Dissemination is central to the success of HEARTEN project. HEARTEN has recognized the dissemination activities as a core activity throughout the project's life. The dissemination activities have been carried out at local, national and international level. The dissemination strategy followed throughout the project is outlined in D2.9 - Dissemination plan and activities 1. The HEARTEN consortium targets the key stakeholders in order to enhance their overall awareness, interest and engagement and promote the communication of the project's results and findings. A core part of the HEARTEN dissemination strategy is the participation of the consortium in relevant events in Europe and worldwide in order to create an informed network of key players in the ICT domain.

The purpose of this deliverable is to present the HEARTEN dissemination activities which have been performed from January 2016- June 2016 (M13-M18). In particular, this document focuses on the main achievements with respect to the key dissemination activities, which are:

- Publications in journals and conference proceedings. Specifically, nine (9) journal articles and one (1) article in conference proceedings have been published. These publications are related to WP4, WP5 and WP6 progress and activities and have been undertaken by FORTH, UNIPI, UMOR, CSIC and UCBL partners.
- Presentation of the project in relevant dissemination events and information material distribution. HEARTEN participated in the Lean LaunchPad Pilot (LLP) (www.europeanlaunchpad.com), which is a European Commission pilot initiative targeting innovators, start-ups and SMEs in the ICT domain. HEARTEN participated in Patras IQ 2016 event (www.patrasiq.gr/) and distributed the project's flyer and information material and also participated in the XIV Mediterranean Conference on Medical and Biological Engineering and Computing (Medicon 2016 - <http://medicon2016.org/>) and came into contact with several researchers and entrepreneurs and health related SMEs.
- New project website development (<http://www.hearten.eu/>). HEARTEN website is a mean of advertising the project research activities and achievements, promoting several events and publications and interacting with the visitors. In addition, apart from a general description of the project, its objectives and its strategy, information of the HEARTEN academic and industrial partners is provided.
- Social media (Facebook, LinkedIn, Twitter) update. Creation/management of accounts and continuous presence of HEARTEN in social media.

2. HEARTEN Dissemination Tools and Activities

The objective of the HEARTEN dissemination strategy is to provide the wide audience with the progress and the findings of the project. This strategy intends to create an impact that will outlive the duration of the project by making the results of the research and development activities known to those who could benefit from them. This target group includes the HF patients, the ecosystem actors, the scientific community, the biosensor market and other stakeholders as defined in *D2.6-Exploitation-Innovation plan 1* (M12). The dissemination activities performed from M13-M18 are summarized in Table 1 and presented in detail hereafter.

Table 1: Dissemination and promotional activities from M13-M18.

Type of activity	Journal articles		Conference papers	
Publications	9		1	
Type of activity	Project Presentations	Flyer distribution	Social Media	Website
Promotional activities	3	1	3	1

2.1 HEARTEN publications

HEARTEN is placing special emphasis upon scientific channels of publications including journal and conference papers, as presented in detail below. The scientific materials submitted this period are related to the results of the WP4, WP5 and WP6, and present the identification and validation of the breath/saliva sensing parameters, the development of the breath/saliva biosensors and the Knowledge management system (KMS) and data mining techniques (Table 2).

Table 2: HEARTEN publications related to WP4, WP5 and WP6.

Related WP	Type of dissemination activity	Number of dissemination materials
WP4	Journal articles	1
WP5	Journal articles	8
WP6	Conference article	1

Conference paper accepted in the 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC'16)

This paper aims to present the HEARTEN Knowledge Management System (KMS) in the experts of Biomedical and Health Informatics area. Specifically, the following information is provided: (i) the nine (9) modules of the KMS, (ii) a description of the data that will be collected during the retrospective data gathering phase, (iii) the frequency of the measurements, (iv) number of the enrolled patients (Figure 1).

HEARTEN: the Heart Failure Knowledge Management System

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Abstract— HEARTEN platform utilizes the advances in communication technologies to monitor clinical and patient variables, enabling the patient to be empowered and adherent and the other ecosystem actors to offer personalized, predictive and preventative care. This is accomplished through the collection of data expressing medical knowledge about heart failure and analysis of data through the HEARTEN Knowledge Management System (KMS). In this study, the overall architecture of the HEARTEN is presented with special emphasis on the KMS.

I. INTRODUCTION

Heart Failure (HF) has become an epidemic worldwide, associated with unpleasant outcomes. New strategies to early detect disease progress and effectively monitor the HF patients will prevent the HF-related hospitalizations and reduce the healthcare costs. HEARTEN is an mHealth collaborative platform that engages all ecosystem actors: the HF patients, their caregivers, the healthcare professionals, the nutritionists, the psychologists and the physical activity experts. It facilitates their intercommunication and tight collaboration for effectively and efficiently monitoring and managing the patient's disease [1]. The HEARTEN architecture includes the: (i) Sensors/Biosensors, (ii) mHealth app, (iii) Web app, (iv) Databases, (v) KMS, (vi) Dynamic Patient Communication Protocol (DYNPCP) components.

II. HEARTEN KMS ARCHITECTURE

HEARTEN KMS consists of nine (9) modules (Fig. 1): (i) NYHA Class Module, which detects if the patient has changed NYHA class, (ii) Association module, which provides interesting interrelations from multiple and heterogeneous data, that reflect the lifestyle, clinical condition and medication of the patients, (iii) Statistics Module, that allows to find and explain dependencies frequently observed within the collected data, (iv) Adherence Risk Module, which provides an estimation regarding the adherence profile of the

patient, (v) Treatment Adherence Module, which examines if the patient is adherent or not with the guidelines provided by the experts, (vi) Score Module, which computes several acknowledged risk scores allowing the experts to build risk profiles for their patients, (vii) Event Prediction module, which predicts the possible presence of adverse events (relapses and mortality) and provides the etiology of the event, (viii) Monitoring-Reporting Module, which combines and presents the output of the rest modules and, (ix) KMS Alerting Mechanism module, which transforms the output of the modules to crucial alerts and messages about the patients' condition and delivers them through the DYNPCP to the ecosystem actors. Selected module outcomes are stored in the Databases and employed as input features to subsequent modules.

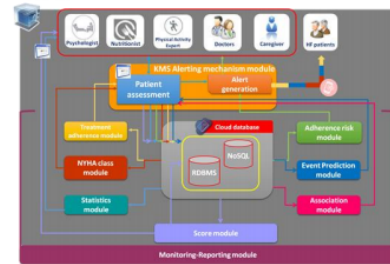


Fig.1 HEARTEN KMS overall architecture.

The functionality of the HEARTEN KMS strongly depends on the data that are collected (general patient information, allergies, drug side effects, medical condition, medication, biological data, clinical examination data, sensor and breath/saliva biosensor data, nutrition data, and recommended treatment). The frequency of measurements is described in the clinical protocol defined by the two clinical partners of the project. 80 patients will be enrolled in order the KMS component to be developed and trained, while 80 more patients will be employed for the whole platform evaluation and the validation. For the preliminary evaluation of the first and the fourth KMS modules, retrospective data from 396 patients are utilized.

REFERENCES

- [1] "HEARTEN: A co-operative mHealth environment targeting adherence and management of patients suffering from Heart Failure.", <http://www.hearten.eu/>.

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Figure 1: Paper accepted in EMBC'16.

The details of the Conference, where the 1-page paper will be presented, are depicted in Table 3.

Table 3: Details of the paper presented in the EMBC'16 Conference.

Conference Title	38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC'16)
Location	Florida USA
Date	August, 2016
Theme of the Conference	Empowering Individual Healthcare Decisions through Technology
Targeted audience	Cutting-edge biomedical and healthcare technology experts

Paper published in "Trends in Analytical Chemistry" Journal

This paper is a review about the magnetic particles that are largely used in various applications and particularly in *in-vitro* biomedical diagnostic and bionanotechnology (Figure 2). In fact, they have been employed for extraction of various biomolecules even from crude samples and as solid support in numerous samples' preparation for *in-vitro* diagnosis. Nowadays, they are also successfully being exploited as a carrier of biomolecules in microsystems, microfluidics, lab-on-a-chip and for detection in specific biosensors. Before any use or any preparation of magnetic hybrid particles, various factors should be considered to perfectly target the suitable applications. For microfluidic, these particles should be colloidal stable to avoid any jump in the microfluidic canals. Regarding the biosensor, these particles need to be chemically well-designed generally to enhance specific detection or specific signal.

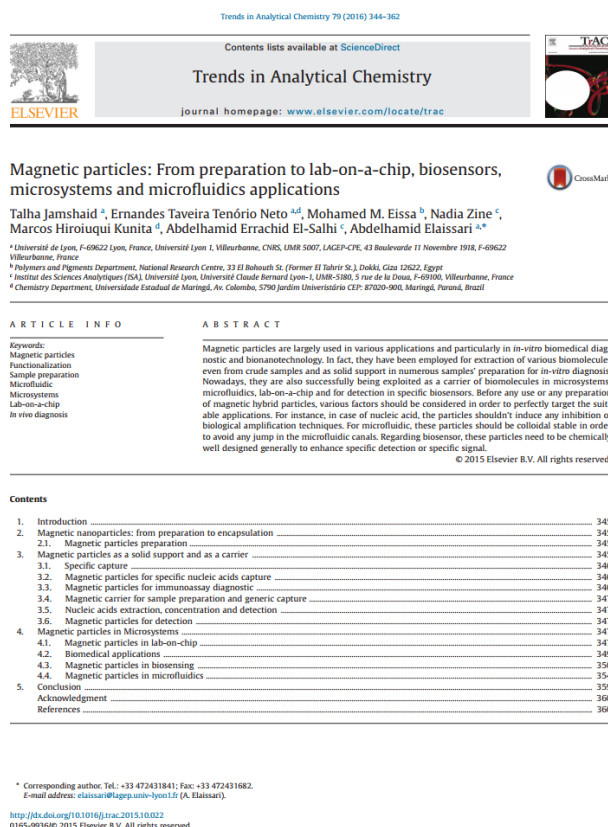


Figure 2: Paper published in "Trends in Analytical Chemistry" Journal.

The details of the paper published in the Journal "Trends in Analytical Chemistry" are presented in Table 4.

Table 4: Details of the paper presented in the Journal "Trends in Analytical Chemistry".

Journal Title	Trends in Analytical Chemistry	Impact Factor	7.487
Targeted audience	Analytical chemistry and instrumentation experts		
Paper title	Magnetic particles: From preparation to lab-on-a-chip, biosensors, microsystems and microfluidics applications		
Volume	79	Date	2016

Paper published in "Electroanalysis" Journal

This paper reports the development of a new concept of label-free impedimetric immunosensors for IL-8 detection (Figure 3). A nanocomposite of gold nanoparticles (AuNPs) decorating a magnetic Fe₃O₄ core is synthesized using cysteamine as linker, and characterized using TEM and UV-Vis spectrometry. After immobilization of these Fe₃O₄@Au magnetic nanocomposites on a boron doped diamond (BDD) electrode using a simple magnet, anti-human IL-8 monoclonal antibody is linked to the AuNPs, previously functionalized with thioctic acid. The functionalization of the immunosensor was characterized using two electrochemical techniques: cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS), performed in phosphate buffer with ferro/ferricyanide as the redox probe. The EIS technique was used for affinity assays: antibody-Antigen binding. A linear relationship between the increment in the electron transfer resistance (RCT) and the logarithmic value of IL-8 concentration was observed between 0.1 pg/mL and 1000 pg/mL. The limit of detection (LOD) was estimated at 0.03 pg/mL.

Full Paper

Wiley Online Library

ELECTROANALYSIS

DOI: 10.1002/elan.201600060

Boron-doped Diamond Electrodes Modified with Fe₃O₄@Au Magnetic Nanocomposites as Sensitive Platform for Detection of a Cancer Biomarker, Interleukin-8.

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Abstract: Interleukin-8 (IL-8), a dimeric protein composed of two identical subunits, is overexpressed in different human cancers, among them pancreatic cancers and head and neck cancers. There is a strong demand for monitoring of this biomarker protein for early cancer detection. A new concept of label-free impedimetric immunosensors for IL-8 detection is described in this work. A nanocomposite of gold nanoparticles (AuNPs) decorating a magnetic Fe₃O₄ core is synthesized using cysteamine as linker, and characterized using TEM and UV-Vis spectrometry. After immobilization of these Fe₃O₄@Au magnetic nanocomposites on a boron doped diamond (BDD) electrode using a simple magnet, anti-human IL-8 mono-

clonal antibody is linked to the AuNPs, previously functionalized with thioctic acid. The functionalization of the immunosensor was characterized using two electrochemical techniques: cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS), performed in phosphate buffer with ferro/ferricyanide as the redox probe. The EIS technique was used for affinity assays: antibody-Antigen binding. A linear relationship between the increment in the electron transfer resistance (R_{ct}) and the logarithmic value of IL-8 concentration was observed between 0.1 pg/mL and 1000 pg/mL. The limit of detection (LOD) was estimated at 0.03 pg/mL.

Keywords: Magnetic nanoparticles • gold nanoparticles • magnetic nanocomposites • label-free impedimetric immunosensor • interleukin-8

1 Introduction

Interleukin-8 (IL-8) is a dimeric protein [1] composed of two identical subunits; it is released from several cell types, including monocytes, fibroblasts, endothelial cells, and keratinocytes, in response to an inflammatory stimulus. A range of *in vitro* and *in vivo* studies have shown that IL-8 possesses two major activities. The first is the selective capacity to attract neutrophils, basophils, and T-cells but not monocytes; the second involves neutrophil activation. It is overexpressed in different human cancers, among them pancreatic cancers [2] and head and neck cancers [3]. It has been demonstrated that IL-8 plays an essential role in tumor progression and metastasis [4]. More than 7000 patients are diagnosed with one of these cancers every year in the US, and half of them die of it. This high mortality rate is due to the difficulty in monitoring biomarker proteins for early detection. Moreover, reliable diagnoses and active monitoring of these types of cancer during therapy requires rapid detection of the level of protein biomarker in blood. This provides a challenging application for immunosensors. The average concentration of IL-8 in serum of a healthy individual is <13 pg/mL, whereas elevated levels for patients with a head and neck cancer are >20 pg/mL [5].

Electrochemical immunosensors present several advantages: their sensitivity, their ease of implementation, the low cost instrumentation required. Electrochemical bio-

sensors used for the detection of cancer or cardiovascular markers are mostly affinity biosensors, based on the detection of the biomarker/affinity molecule complex, the specific affinity molecule being an antibody or an aptamer is immobilized on the electrode surface. These biosensors usually employ amperometric, potentiometric or impedimetric transducers. The biomarker/affinity molecule complex can be detected directly through the charge transfer rate of a redox probe (in solution or attached to the affinity molecule) or in a sandwich configuration with a redox-labeled secondary antibody [6,7]. Among electrochemical techniques, impedimetry allows sensitive, label-free detection of the formation of the antigen-antibody complex on the electrode surface [8]. Moreover, the measuring medium can be different from the incubation medium, which could allow non-specifically adsorbed species to be flushed out. To fabricate a stable and sensitive electrochemical immunosensor, the strategy used to immobilize the antibody onto the electrode surface is one of

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Figure 3: Paper published in "Electroanalysis" Journal.

The details of the paper published in the Journal "Electroanalysis" are presented in Table 5.

Table 5: Details of the paper presented in the Journal "Electroanalysis".

Journal Title	Electroanalysis	Impact Factor	2.138
Targeted audience	Electrochemical sensor experts		
Paper title	Boron-doped Diamond Electrodes Modified with Fe ₃ O ₄ @Au Magnetic Nanocomposites as Sensitive Platform for Detection of a Cancer Biomarker, Interleukin-8		
Volume	28	Date	2016

Paper published in "Sensors and Actuators B: Chemicals" Journal

This paper reports the development of a novel capacitance electrochemical biosensor based on a silicon nitride substrate, combined with a new structure of magnetic nanoparticles (Figure 4). Electrochemical measurements were carried out for the detection of ochratoxin-A. The biosensor was highly sensitive and specific for ochratoxin-A antigens, with a limit of detection of 4.57 pM.



1. Introduction

Ochratoxin A (OTA), is a secondary fungal metabolite produced by various *Aspergillus* and *Penicillium* strains, which was found to be one of the predominant contaminating mycotoxins in a wide variety of food commodities such as cereals, dried fruits, nut, spices, coffee beans, cocoa, beer, wine, etc [1–3]. In the European Union, some regulatory limits have already been introduced for the levels of OTA in food products such as raw cereal grains (5 µg/kg), dried fruits (10 µg/kg), roasted coffee and coffee products (5 µg/kg), grape juice (2 µg/kg) (EC No. 123/2005) and also

for all types of wines (2 µg/kg) [4]. Currently, the methods commonly used for OTA detection are based on high-performance liquid chromatography (HPLC) with fluorescent detection [5]; the LOD of the proposed method was 0.0025 µg/L. However, HPLC is laborious, time-consuming, and requires sophisticated equipment and qualified personnel. Furthermore, gas chromatography coupled with mass spectrometry (GC-MS) [6] or enzyme-linked immunosorbent assay (ELISA) [7] have also been used for OTA detection and the LOD was around 0.15 ng/mL. Although this technique is used for rapid screening and allows multiple analyses in a short time, it remains limited by using labeled bio reagents which are expensive. To overcome the above limitations, several types of biosensors have aroused the interest of researchers for OTA detection.

In the last years, several optical and electrochemical techniques based on biosensors have been investigated for OTA detection [8–10]. Liu et al. have reported about an ultrasensitive electrochem-

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Figure 4: Paper accepted in "Sensors and Actuators B: Chemicals" Journal.

The details of the paper accepted in the Journal "Sensors and Actuators B: Chemicals" are presented in Table 6.

Table 6: Details of the paper presented in the Journal "Sensors and Actuators B: Chemicals".

Journal Title	Sensors and Actuators B: Chemicals	Impact Factor	1.472
Targeted audience	Experts in the field of chemical sensors, actuators and microsystems.		
Paper title	Development of a novel capacitance electrochemical biosensor based on silicon nitride for ochratoxin A detection		
Volume	234	Date	2016

Paper published in "Electroanalysis" Journal

A K⁺-sensitive capacitive electrolyte-membrane-insulator-semiconductor (EMIS) based on a novel dibromoaza[7]helicene ionophore has been developed and presented in this paper (Figure 5). An ion-sensitive membrane based on polyvinylchloride (PVC) doped with the ionophore was deposited on the Si₃N₄/SiO₂/Si-p/Cu-Al transducer. The properties of the K⁺-EMIS chemical sensor were investigated by electrochemical impedance spectroscopy (EIS). All the developed devices upon being tested have shown good sensitivity and linearity responses within the range 10⁻⁶ M to 10⁻¹ M of potassium activity, with good selectivity over a wide variety of other cations (Na⁺, Li⁺, Cu²⁺, Ca²⁺, and Mg²⁺). To our knowledge, this is the first time that a capacitive field-effect sensor has been fabricated using helicene as a carrier for a K⁺-detection, combined with the structure Si₃N₄/SiO₂/Si-p/Cu-Al as a transducer.



Figure 5: Paper (No.2) published in "Electroanalysis" Journal.

The details of the paper (No2) published in the Journal "Electroanalysis" are presented in Table 7.

Table 7: Details of the paper (No.2) presented in the Journal "Electroanalysis".

Journal Title	Electroanalysis	Impact Factor	2.138
Targeted audience	Electrochemical sensor experts		
Paper title	Electrochemical Capacitive K+ EMIS Chemical Sensor Based on the Dibromoaza[7]helicene as an Ionophore for Potassium Ions Detection		
Volume	28	Date	2016

Paper published in "Materials Research Bulletin 2016" Journal

In this study, gold nanoparticles were prepared by using different concentrations of reducing agent (NaBH_4) in various formulations and their effect on the particle size, size distribution and morphology was investigated (Figure 6). Moreover, special attention has been dedicated to comparison of particles size measured by various techniques, such as, light scattering, transmission electron microscopy, UV spectrum using standard curve and particles size calculated by using Mie theory and UV spectrum of gold nanoparticles dispersion. Particle size determined by various techniques can be correlated for monodispersed particles and excess of reducing agent leads to increase in the particle size.

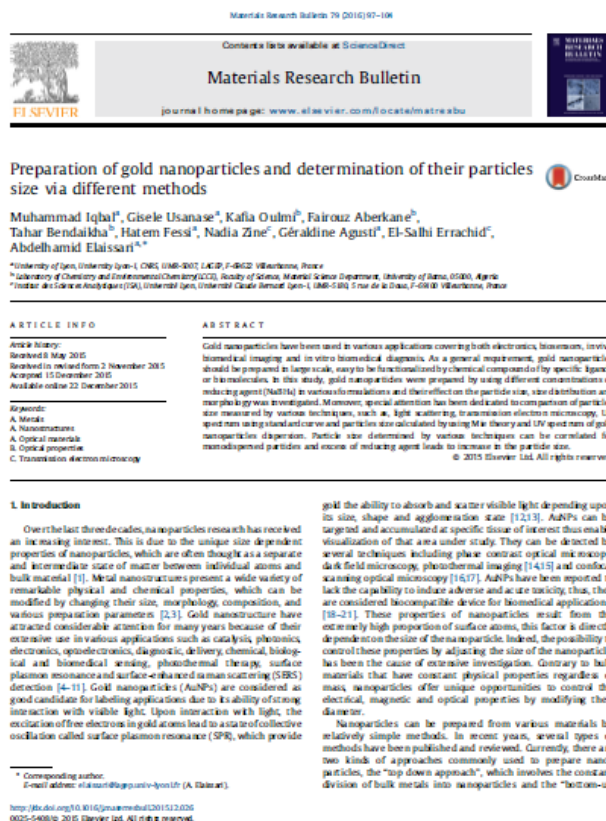


Figure 6: Paper published in "Materials Research Bulletin" Journal.

The details of the paper published in the Journal "Materials Research Bulletin" are presented in Table 8.

Table 8: Details of the paper presented in the Journal "Materials Research Bulletin".

Journal Title	Materials Research Bulletin	Impact Factor	2.435
Targeted audience	Experts in functional inorganic materials and nanomaterials		
Paper title	Preparation of gold nanoparticles and determination of their particles size via different methods		
Volume	79	Date	2016

Paper published in “Materials Science and Engineering C” Journal

In this work, the development of new Aza[7]helicene-containing PVC-based membranes for the K⁺ ions quantification is presented (Figure 7). Silicon nitride-based structures (Si-p/SiO₂/Si₃N₄) were developed and the surface was activated, functionalized with an aldehyde–silane (11-(Triethoxysilyl)undecanal (TESUD)), functionalized with polypyrrole (PPy), and coated with the polyvinylchloride (PVC)-membrane containing the Aza[7]helicene as ionophore. All stages of functionalization process have been thoroughly studied by contact angle measurements (CAMs) and atomic force microscopy (AFM). The developed ion-selective electrode (ISE) was then applied using electrochemical impedance spectroscopy (EIS) for the detection of potassium ions. A linear range was observed between 1.0×10^{-8} M to 1.0×10^{-3} M and a detection limit of 1.0×10^{-8} M was observed. The EIS results have showed a good sensitivity to potassium ion using this novel technique.

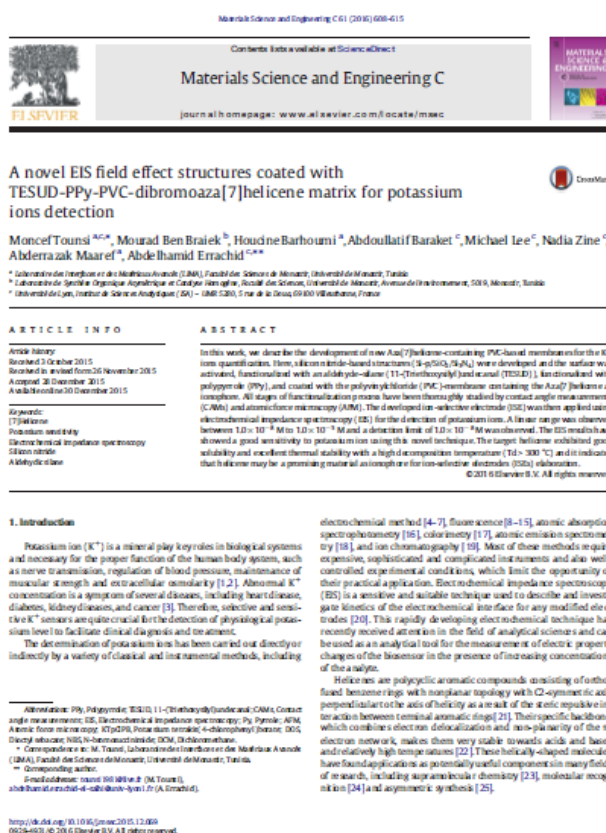


Figure 7: Paper published in “Materials Science and Engineering C” Journal.

The details of the paper published in the Journal “Materials Science and Engineering C” are presented in Table 9.

Table 9: Details of the paper presented in the Journal “Materials Science and Engineering C”.

Journal Title	Materials Science and Engineering C	Impact Factor	3.338
Targeted audience	Experts in biomedical sciences and materials engineering		
Paper title	A novel EIS field effect structures coated with TESUD-PPy-PVC-dibromoaza[7]helicene matrix for potassium ions detection		
Volume	61	Date	2016

Paper published in “Materials Science and Engineering C” Journal

The aim of this work was to prepare highly magnetic particles with a magnetic core and conducting polymer shell particles in order to be used not only as a carrier, but also for the in vitro detection step (Figure 8). The prepared magnetic seed dispersions were functionalized using pyrrole and pyrrole-2-carboxylic acid. The obtained core-shell particles were characterized in terms of particle size, size distribution, magnetization properties, FTIR analysis, surface morphology, chemical composition, and finally, the conducting property of those particles were evaluated by cyclic voltammetry. The obtained functional submicron highly magnetic particles are found to be conducting material bearing function carboxylic group on the surface. These promising conducting magnetic particles can be used for both transport and lab-on-a-chip for detection of cytokines.



Figure 8: Paper (No2) published in “Materials Science and Engineering C” Journal.

The details of the paper (No2) published in the Journal “Materials Science and Engineering C” are presented in Table 10.

Table 10: Details of the paper (No2) presented in the Journal “Materials Science and Engineering C”.

Journal Title	Materials Science and Engineering C	Impact Factor	3.338
Targeted audience	Experts in biomedical sciences and materials engineering		
Paper title	Submicron magnetic core conducting polypyrrole polymer shell: Preparation and characterization		
Volume	61	Date	2016

Paper published in "International Journal of Environmental Analytical Chemistry" Journal.

A novel inhibition biosensor used for the detection of sulphides (Na_2S) has been developed (Figure 9). The biosensor is based on the immobilization of horseradish peroxidase (HRP) on the Sonogel-Carbon (SNGC) electrode using glutaraldehyde, Poly(4-vinylpyridine) and gold sononanoparticles (AuSNPs). The Poly(4-vinylpyridine) was used due to its high affinity for sulphide anions, while the presence of gold sononanoparticles enhances the electron transfer reaction and improves the analytical performance of the biosensor. The amperometric measurements were performed at an applied potential of -0.15 V vs. Ag/AgCl in 50 mM sodium acetate buffer solution $\text{pH} = 6.0$. The apparent kinetic parameters (K_{mapp} , V_{max}) of immobilised HRP were calculated in the absence of inhibitor (sulphide) using caffeic acid as substrate. Under the optimal experimental conditions, the determination of sulphide can be achieved in a dynamic range of $0.4\text{--}2.8 \text{ }\mu\text{M}$ with a low limit of detection of $0.15 \text{ }\mu\text{M}$. The electrochemical impedance spectroscopy (EIS) was also used to characterise the interactions of substrate and inhibitor with the enzyme-modified electrode.

A novel amperometric inhibition biosensor based on HRP and gold sononanoparticles immobilised onto Sonogel-Carbon electrode for the determination of sulphides

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ABSTRACT

A novel inhibition biosensor used for the detection of sulphides (Na_2S) has been developed. The biosensor is based on the immobilisation of horseradish peroxidase (HRP) on the Sonogel-Carbon (SNGC) electrode using glutaraldehyde, Poly(4-vinylpyridine) and gold sononanoparticles (AuSNPs). The Poly(4-vinylpyridine) was used due to its high affinity for sulphide anions, while the presence of gold sononanoparticles enhances the electron transfer reaction and improves the analytical performance of the biosensor. The amperometric measurements were performed at an applied potential of -0.15 V vs. Ag/AgCl in 50 mM sodium acetate buffer solution $\text{pH} = 6.0$. The apparent kinetic parameters (K_{mapp} , V_{max}) of immobilised HRP were calculated in the absence of inhibitor (sulphide) using caffeic acid as substrate. Under the optimal experimental conditions, the determination of sulphide can be achieved in a dynamic range of $0.4\text{--}2.8 \text{ }\mu\text{M}$ with a low limit of detection of $0.15 \text{ }\mu\text{M}$. The electrochemical impedance spectroscopy (EIS) was also used to characterise the interactions of substrate and inhibitor with the enzyme-modified electrode. The developed biosensor exhibited high sensitivity, selectivity and stability, and can be successfully applied to the detection of sulphide in water.

ARTICLE HISTORY

Received 15 November 2015
Accepted 19 March 2016

KEYWORDS

Enzyme biosensor; gold sononanoparticles; horseradish peroxidase; poly(4-vinylpyridine); Sonogel-Carbon electrode; sulphide

Figure 9: Paper published in "International Journal of Environmental Analytical Chemistry" Journal.

The details of the paper published in the Journal "International Journal of Environmental Analytical Chemistry" are presented in Table 11.

Table 11: Journal "International Journal of Environmental Analytical Chemistry".

Journal Title	International Journal of Environmental Analytical Chemistry	Impact Factor	1.411
Targeted audience	Experts in the most advanced analytical technologies		
Paper title	A novel amperometric inhibition biosensor based on HRP and gold sononanoparticles immobilised onto Sonogel-Carbon electrode for the determination of sulphides		
Volume	96	Date	2016

Paper published in “Microchimica Acta 2016” Journal

The paper reports a simple method to manufacture an electrochemical micro lab-on-chip, for the detection of interleukin-10 cytokine of patients suffering from heart failure (HF) (Figure 10). To monitor the critical levels of inflammation, a lab-on-chip containing eight gold microelectrodes based on a polyimide substrate was fabricated. IL-10 was quantified by electrochemical impedance spectroscopy measurements, within the range of 1–15 pg/mL.

Microchim Acta
DOI 10.1007/s00604-016-1847-y

ORIGINAL PAPER



A flexible electrochemical micro lab-on-chip: application to the detection of interleukin-10

Abdoulatif Baraket¹ · Michael Lee¹ · Nadia Zine¹ · Nourdin Yaakoubi² ·
Joan Bausells³ · Abdelhamid Errachid¹

Received: 17 January 2016 / Accepted: 7 April 2016
© Springer-Verlag Wien 2016

Abstract We report on a simple method to manufacture an electrochemical micro lab-on-chip (μLoC), for the detection of interleukin-10 (IL-10) cytokine of patients suffering from heart failure (HF). To monitor the critical levels of inflammation, a μLoC containing eight gold microelectrodes based on a polyimide (PI) substrate was fabricated. The microelectrodes were manufactured on PI by a combination of soft lithographical tools. To produce an operational μLoC, a microfluidic system fabricated in polydimethylsiloxane was sealed onto the PI substrate through silane reagent (3-aminopropyltriethoxysilane). Cyclic voltammetry was applied as the characterization technique for the gold microelectrode surface properties. Finally, electrochemical characterization of the μLoC was determined by electrochemical impedance spectroscopy for the quantification of IL-10. These were detected within the range of 1–15 pg mL⁻¹. The time and cost of

fabrication for this μLoC was very low when compared to those that have been fabricated by conventional lithography.

Keywords Heart failure · Micro lab-on-chip · Soft lithography · Polyimide substrate · Electrochemical impedance spectroscopy

Introduction

The micro Lab-on-chip (μLoC) has been widely exploited for medical applications over the last decade [1]. Generally, these μLoCs integrate (multiple) laboratory functions on a single chip of only millimeters to a few square centimeters in size and are capable of handling extremely small fluid volumes [2]. They are usually manufactured from a combination of microelectromechanical system (MEMS) devices or Micro Total Analysis Systems (μTAS) with a microfluidic system [3].

Microfluidic technologies have been widely developed and there has been an explosive growth for a wide range of applications. These include miniaturized chemical mixing, separation processes, biochemical analysis, etc. [4]. Besides the high control for all process measurements, the application of microfluidic systems that require small sample and reagent volumes has attracted the increased attention of researchers within this field. This has proved to be a significant benefit for research in this technology. However, the manufacturing of these active and smart microfluidic devices such as microvalves and micropumps for fluidic flow control [5, 6] has created high costs, difficulty in integration, complex fabrication, and complex control circuitry. Therefore, recent research has been significantly focused towards the use of simple microfluidic structures to compensate the cost and time of fabrication as well as the ease of use of these microfluidic

This work was first presented at the 7th Int. Workshop on «Biosensors for Food Safety and Environmental Monitoring» (held in Erfoud, Morocco, 19–21 Nov. 2015).

Electronic supplementary material The online version of this article (doi:10.1007/s00604-016-1847-y) contains supplementary material, which is available to authorized users.

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Published online: 20 April 2016

 Springer

Figure 10: Paper published in “Microchimica Acta” Journal.

The details of the paper published in the Journal “Microchimica Acta” are presented in Table 12.

Table 12: Details of the paper presented in the Journal “Microchimica Acta”.

Journal Title	Microchimica Acta	Impact Factor	4.831
Targeted audience	Experts in the field of micro-/nanomaterials such as micro- and nanoparticles, imprints, micro/nanodroplets, or micro/nanostructured devices for use in (bio)analytical applications.		
Paper title	A flexible electrochemical micro lab-on-chip: application to the detection of interleukin-10		
Volume	183	Date	2016

Paper accepted in "Scientific Reports" Journal.

This paper reports the effects of hemodynamic and respiratory parameters on breath VOC profiles (Figure 11). The work demonstrated that project relevant VOC biomarkers such as isoprene or acetone mirror cardiac output and minute ventilation, respectively. In a perspective monitoring of exhaled VOC concentrations may, therefore, provide additional information on physiology of respiration and gas exchange and could supplement clinical tests such as FEV1.

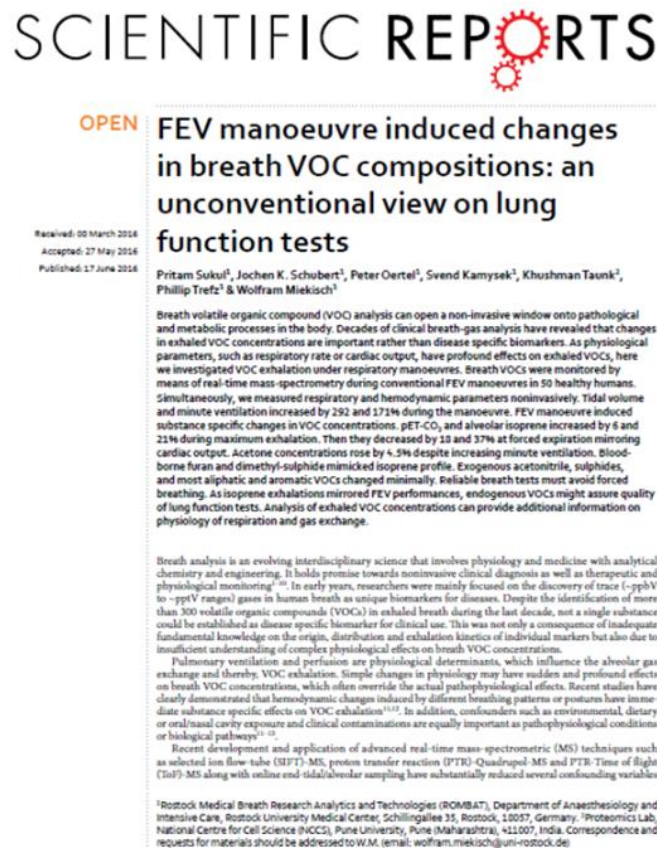


Figure 11: Paper accepted in "Scientific Reports" Journal.

The details of the paper accepted in the Journal "Scientific Reports" are presented in Table 13.

Table 13: Details of the paper presented in the Journal "Scientific Reports".

Journal Title	Scientific Reports	Impact Factor	5.228
Targeted audience	Experts in all areas of the natural and clinical sciences		
Paper title	FEV manoeuvre induced changes in breath VOC compositions: an unconventional view on lung function tests		
Volume	17	Date	2016

2.2 HEARTEN presentation/flyer distribution

HEARTEN presentation in Lean LaunchPad Pilot (LLP)

HEARTEN participated in the LLP and presented a short presentation “Elevator pitch” in front of the other teams, coaches and invited investors (Figure 12). LLP is a European Commission pilot initiative, tailored around innovators, start-ups and SMEs in the ICT domain. The aim of the event is to increase the chances of a successful commercialisation and validate the business and exploitation purposes of new products and services by adapting the EU training context based on the Lean LaunchPad methodology. The event took place in Rome (12-13/01, 5/02, 23-24/02).

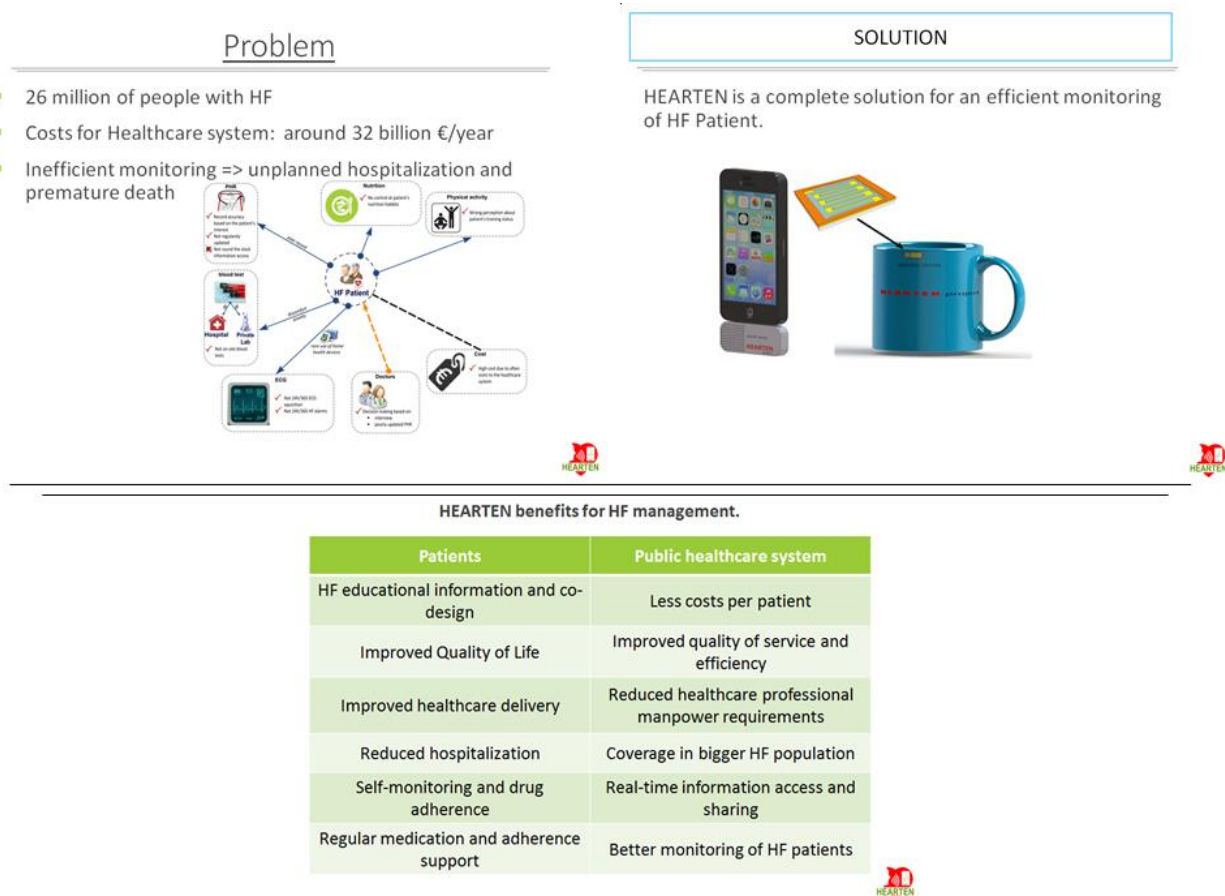


Figure 12: HEARTEN presentation in LLP.

The details of the LLP event are presented in Table 14.

Table 14: LLP event details.

Event	LLP
Location	Rome
Date	2016
Organization	Launched by the European Commission
Targeted audience	European researchers, new ventures and entrepreneurs in the ICT domain

HEARTEN abstract in “Abriendo fronteras a la I+D+i en salud: experiencias en proyectos internacionales 2013-2015”

HEARTEN created an abstract that was published in the report “Abriendo fronteras a la I+D+i en salud: experiencias en proyectos internacionales 2013-2015”, by the Office of International Projects of the Andalusian Public Health System (OIP-APHS) (Figure 13).

ABRIENDO FRONTERAS A LA I+D+I EN SALUD: EXPERIENCIAS EN PROYECTOS INTERNACIONALES

Proyecto:
HEARTEN - A COOPERATIVE MHEALTH ENVIRONMENT TARGETING ADHERENCE AND MANAGEMENT OF PATIENTS SUFFERING FROM HEART FAILURE

Grupo I+D+i



Investigador Principal:
Carlos Luis Parra Calderón

Centro:
Hospitales Universitario Virgen del Rocío y Virgen Macarena

Grupo Investigación:
Investigación e Innovación en Informática e Ingeniería Biomédicas y Economía de la Salud

Responsable del Grupo:
Carlos Luis Parra Calderón

Provincia:
Sevilla

Proyecto

Áreas científicas de interés:

- Informática Biomédica
- Ingeniería Biomédica
- Economía de la Salud
- Innovación en Tecnología Sanitaria

Líneas de investigación

- eSalud
- Historia de Salud electrónica
- Interoperabilidad de la información clínica
- Soporte a la Decisión Clínica
- Soporte a la Decisión Quirúrgica
- Soporte a la Investigación Clínica y Traslacional

Resumen del proyecto:

La insuficiencia cardíaca es la principal causa de mortalidad y de mala calidad de vida en las sociedades occidentales, y los pacientes que la sufren a menudo incumplen las recomendaciones y tratamientos médicos. El objetivo de HEARTEN es diseñar, desarrollar y validar un entorno cooperativo TIC que permita a los pacientes con insuficiencia cardíaca adquirir nuevos hábitos de comportamiento con respecto a la adherencia y al cumplimiento al tratamiento, involucrando a todos los actores que participan en la gestión de este tipo de pacientes, mejorando de esta manera su salud y calidad de vida. Para cubrir este objetivo, se está trabajando en el desarrollo de biosensores que detecten novedosos biomarcadores en saliva y aliento, reflejando el estado de salud del paciente y determinando si éste está cumpliendo el tratamiento. La información registrada por estos biosensores, en combinación con una serie de sensores convencionales e información sobre nutrición que el paciente registra directamente en una App, se transmitirá a una arquitectura en la nube donde un sistema de gestión del conocimiento la analizará y generará alertas, guías, tendencias y modelos predictivos.

Entidad financiadora:
European Commission

Programa:
Horizon 2020 (H2020)

Tipo de Participación:
Socio

Fecha de inicio:
01/01/2015

Duración:
36 meses

Financiación recibida:
345.625,00 €

Web del proyecto:
<http://www.hearten.eu/>

Figure 13: HEARTEN abstract published in the report “Abriendo fronteras a la I+D+i en salud: experiencias en proyectos internacionales 2013-2015”.

HEARTEN presentation in XIV Mediterranean Conference on Medical and Biological Engineering and Computing (MEDICON 2016)

HEARTEN participated in Medicon Conference (<http://medicon2016.org/>) where the paper entitled “The evolution of mHealth interventions in Heart Failure: A Review and Framework for Development” was presented (Figure 14, Figure 15). Specifically, the already available mHealth interventions in Cardiology were presented with special emphasis on HEARTEN platform.

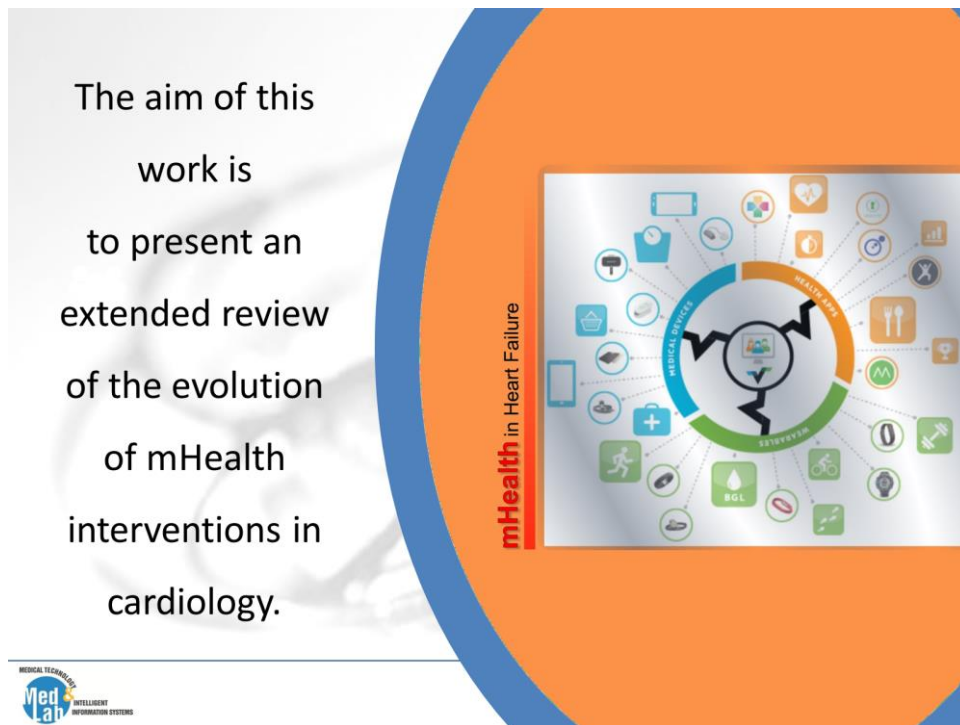


Figure 14: HEARTEN presentation in Medicon Conference (slide1).

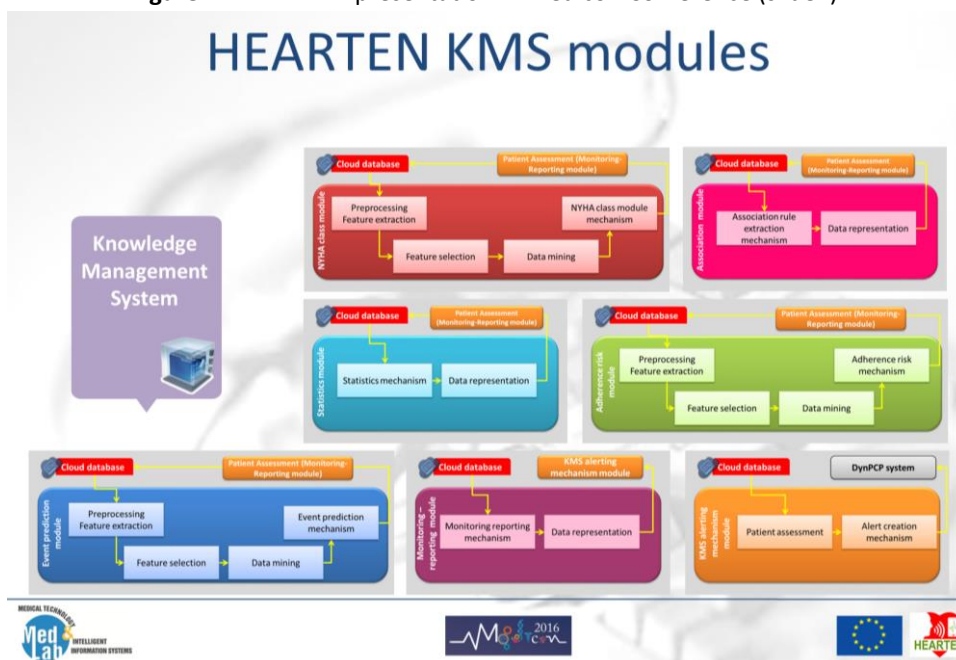


Figure 15: HEARTEN presentation in Medicon Conference (slide2).

HEARTEN participation in Patras IQ 2016 event

In this event, HEARTEN distributed the project's flyer (Figure 16), approached and came into contact with several researchers and entrepreneurs and enabled the conditions for building networks and disseminate HEARTEN vision, findings and progress.

HEARTEN
mHealth cooperative enviroment

The **HEARTEN project** aims at designing, developing & validating an ICT co-operative environment that will enable the HF patients to achieve sustainable behavior change regarding adherence & compliance & the ecosystem actors to be engaged & improve the patients' HF management.



HEARTEN ecosystem



HEARTEN

HEARTEN ecosystem

HEARTEN ecosystem actors:

- UPF Lyon 1
- Lyon Ingenierie Projets
- everis
- AppArt SA
- Foundation For Research And Technology Hellas
- Agencia Estatal Consejo Superior De Investigaciones Cientificas
- Universitätsmedizin Rostock
- Universita Di Pisa
- Servicio Andaluz De Salud
- Your Data SRL
- Caredome Patient Support And Healthcare Solutions
- SESA NV Srl

<http://www.hearten.eu/>

mHealth cooperative enviroment targeting adherence of Heart Failure patients

Empowering patient to manage their own health & HF disease will result in more cost-effective healthcare systems by improving utilization of healthcare, enabling the HF management outside institutions & improving health outcomes.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 643694.

Figure 16: HEARTEN flyer distributed in “Patras IQ 2016” event.

The details of the Patras IQ 2016 event are presented in Table 15.

Table 15: Patras IQ 2016 event details.

Event	Patras IQ 2016
Location	Greece
Date	2016
Targeted audience	Several universities, research institutions and SMEs

HEARTEN flyer translation

In addition the same flyer has been translated in Spanish and Italian to be understandable by the Italian and Spanish audience (Figure 17, Figure 18, Figure 19, Figure 20).

HEARTEN
Entorno cooperativo de salud en movilidad

El proyecto HEARTEN tiene como objetivo diseñar, desarrollar y validar un entorno cooperativo TIC que aumente la adherencia y el cumplimiento del tratamiento farmacológico de los pacientes con IC, y que mejore la gestión de este tipo de pacientes por parte del resto de actores que participan en su atención.



Entorno cooperativo de salud en movilidad en relación a la adherencia de pacientes con Insuficiencia Cardíaca

Ofrecer al paciente un entorno cooperativo para gestionar su propia salud y enfermedad permitirá aplicar intervenciones coste-efectivas, optimizando el uso de los recursos sanitarios, habilitando la gestión de la IC fuera de las instituciones y mejorando los resultados en salud.

Este proyecto está siendo financiado por el programa "Horizon 2020 research and innovation programme" de la Unión Europea, bajo el grant agreement número 643694.

Ecosistema HEARTEN



Partners:

- Universite Lyon 1 Claude Bernard
- Lyon Ingenierie Projets
- everis
- AppArt SA
- Foundation For Research And Technology Hellas
- Agencia Estatal Consejo Superior De Investigaciones Científicas
- Universitätsmedizin Rostock
- Universita Di Pisa
- Servicio Andaluz De Salud
- Your Data SRL
- Caredome Patient Support And Healthcare Solutions
- SESA NV Srl

<http://www.hearten.eu/>

Figure 17: HEARTEN flyer translated to Spanish. Front page.

Elementos clave del sistema HEARTEN

- Biosensores que detectan y cuantifican biomarcadores novedosos de IC
 - biosensor en aliento (Smartphone)
 - biosensor en saliva (taza del paciente)
- ECG, presión arterial, temperatura corporal, peso y actividad física
- Datos de entrada sobre información nutricional y el perfil del paciente
- Arquitectura de referencia en la nube

INTERVENCIÓN HEARTEN

DISPOSITIVOS DE MONITORIZACIÓN
DISPOSITIVOS PORTÁTILES


Tecnologías en la nube
Inteligencia artificial
Alertas inteligentes
Resultados inmediatos

Objetivos científicos y tecnológicos

- Monitorización continua de biomarcadores específicos en aliento/saliva.
- Monitorización continua de constantes vitales.
- Desarrollo de aplicaciones de salud en movilidad para los actores del ecosistema.
- Identificación de tendencias y patrones de falta de adherencia.
- Integración de los diferentes componentes y creación de un entorno TIC cooperativo.
- Educación y orientación para los actores del ecosistema.
- Creación de un ecosistema interactivo para la gestión integral de la IC.

HEARTEN Un entorno cooperativo de salud en movilidad en relación a la adherencia y gestión de pacientes con Insuficiencia Cardíaca

Noticias y Anuncios en <http://www.hearten.eu/>



Objetivos científicos y tecnológicos

- Monitorización
- Sensores
- Movilidad
- Tecnologías de la información
- Salud
- Experiencia clínica
- Historia Clínica Electrónica
- Algoritmos
- Alertas
- Automatización
- Integración

Síguenos!




Figure 18: HEARTEN flyer translated in Spanish. Inner page.

HEARTEN Ambiente cooperativo mHealth

TL'obiettivo del progetto HEARTEN è progettare, sviluppare e validare un ambiente cooperativo TIC che permetta ai pazienti affetti da scompenso cardiaco di adottare modifiche comportamentali sostenibili per una migliore aderenza e conformità alla terapia, ed una maggiore partecipazione da parte degli attori dell'ecosistema al fine di migliorare la gestione dei pazienti con scompenso



Universite Lyon 1
Claude Bernard

Lyon Ingenierie
Projets

everis Spain SL

AppArt SA

Foundation For Research
And Technology Hellas

Agencia Estatal Consejo
Superior De
Investigaciones Cientificas

Universitätsmedizin
Rostock

Universita Di Pisa

Servicio Andaluz De Salud

Your Data SRL

Caredome Patient Support
And Healthcare Solutions

SESA NV Srl

<http://www.hearten.eu/>

L'ecosistema HEARTEN



Ambiente cooperativo mHealth per migliorare l'aderenza alla terapia dei pazienti affetti da Scompenso Cardiaco


Mettere il paziente in grado di gestire meglio la propria salute e lo scompenso cardiaco renderà i sistemi sanitari economicamente più efficienti. Inoltre, permettendo la gestione dello Scompenso Cardiaco fuori dagli Enti Ospedalieri si favorirà un

Questo progetto è finanziato dal programma di Ricerca e Innovazione dell'Unione Europea Horizon 2020, accordo di sovvenzione n. 643694

Figure 19: HEARTEN flyer translated in Italian. Front page.

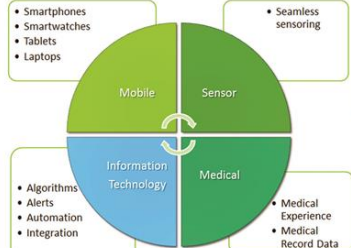
Elementi principali del sistema HEARTEN

- Biosensori che rilevano e quantificano nuovi bio-marcatori dello scompenso cardiaco nella saliva e nell'espriato
 - Biosensore dell'espriato
 - Biosensore della saliva
- ECG, pressione sanguigna, bilancia pesapersona & sensori di attività fisica
- Inserimento dati con informazioni nutrizionali & profilo del paziente
- Architettura cloud di riferimento HEARTEN




Obiettivi scientifici e tecnologici

- Monitoraggio continuo di specifici bio-marcatori nella saliva e nell'espriato
- Monitoraggio continuo dei segnali vitali e delle misurazioni
- Sviluppo delle app mHealth per i pazienti e gli attori dell'ecosistema
- Identificazione di tendenze e modelli di non-aderenza
- Integrazione di differenti componenti & creazione di un ambiente cooperativo TIC
- Formazione e assistenza per gli attori dell'ecosistema
- Creazione di un ecosistema interattivo e di supporto per la gestione olistica dello scompenso cardiaco



HEARTEN Ambiente cooperativo mHealth per migliorare l'aderenza alla terapia e la gestione dei pazienti affetti da Scompenso Cardiaco

News & Announcements at <http://www.hearten.eu/>



Seguici su




Figure 20: HEARTEN flyer translated in Italian. Inner page.

2.3 HEARTEN Website

HEARTEN website (<http://www.hearten.eu/>) is the primary dissemination route through which the project is presented and aims to meet the communication needs of a wide range of users (Figure 21).

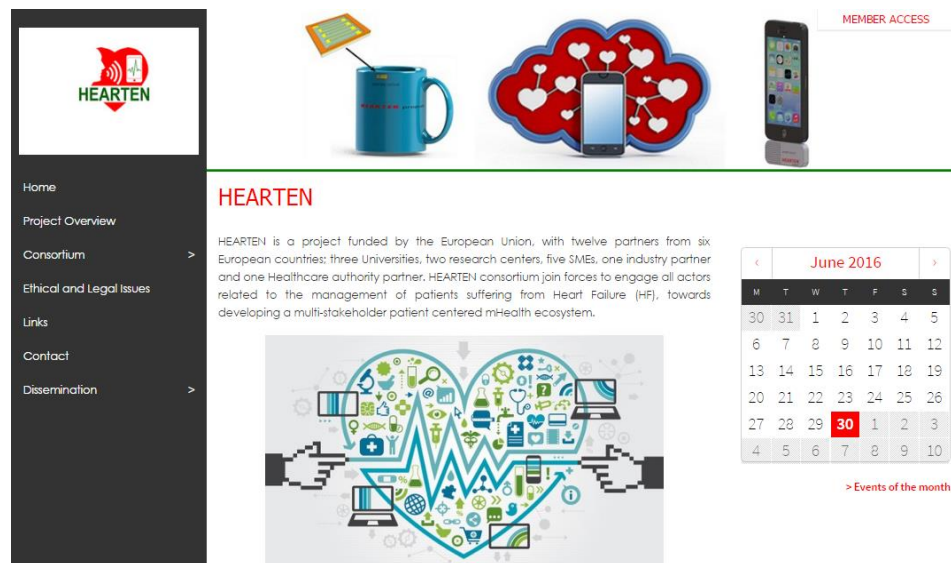


Figure 21: HEARTEN website main page.

On the HEARTEN website, comprehensive information about the project and related information can be found. Apart from advertising the project research activities and achievements, the website promotes events and publications, but it is also a tool where interaction can take place. This applies equally to internal and external communication.

The website already includes apart from a general description of the project, its objectives and its strategy, a presentation of the consortium including background information on the academic and industrial participants and their contact information (Figure 22).

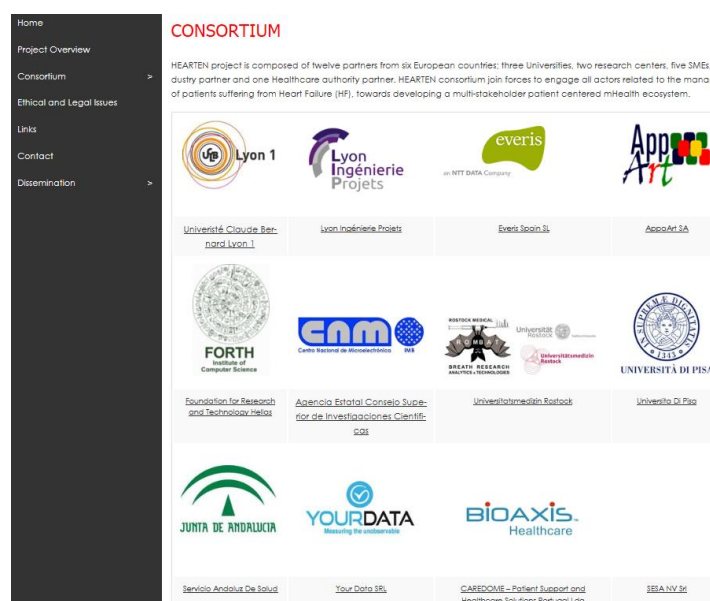


Figure 22: HEARTEN website - Consortium information.

The website includes links to published journal and conference papers, commentary and news on corresponding subjects. The website content is regularly updated, in particular with summaries of the project progress, so as the visitors can be informed adequately. A dedicated section on Ethics is already created and will be regularly updated (Figure 23).

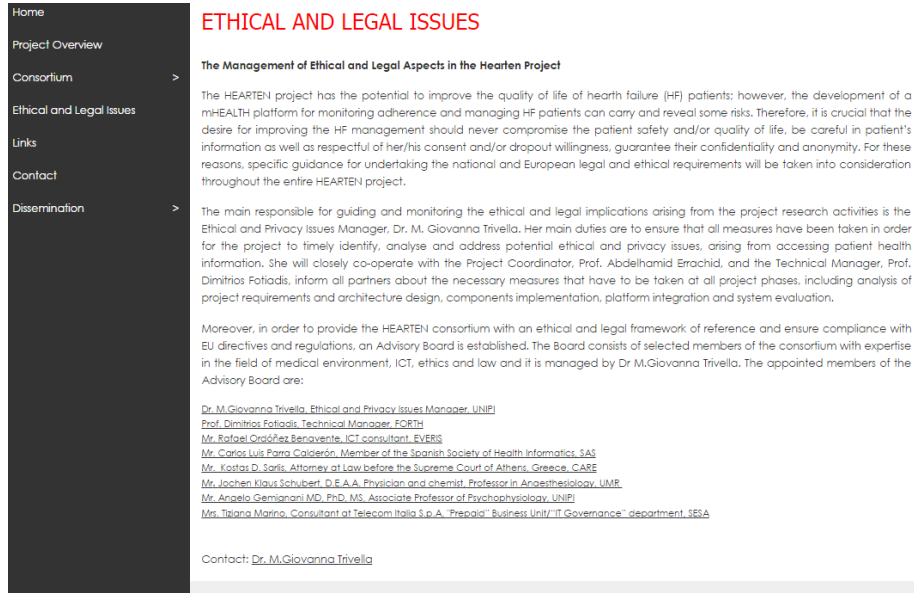


Figure 23: HEARTEN website – Ethical and Legal Issues.

A private area, only for registered project members, has been created. This part includes a document repository where reports, working documents, information related to meetings, templates and communication tools, etc. are included. Each authorized member of the HEARTEN consortium is able to access the restricted area through user credentials and upload documents.

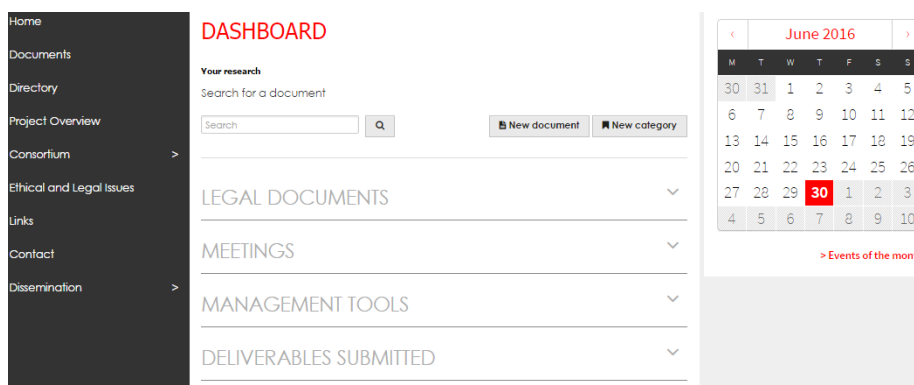


Figure 24: HEARTEN website – Internal area.

2.4 HEARTEN in Social media

. HEARTEN has an active participation in the social media, such as **Facebook** (<https://www.facebook.com/pages/HEARTEN-Project/605460052917539>), **Twitter** (<https://twitter.com/heartenh2020>) and **LinkedIn** (<https://www.linkedin.com/in/heartenproject>) (Figure 25, Figure 26, Figure 27).

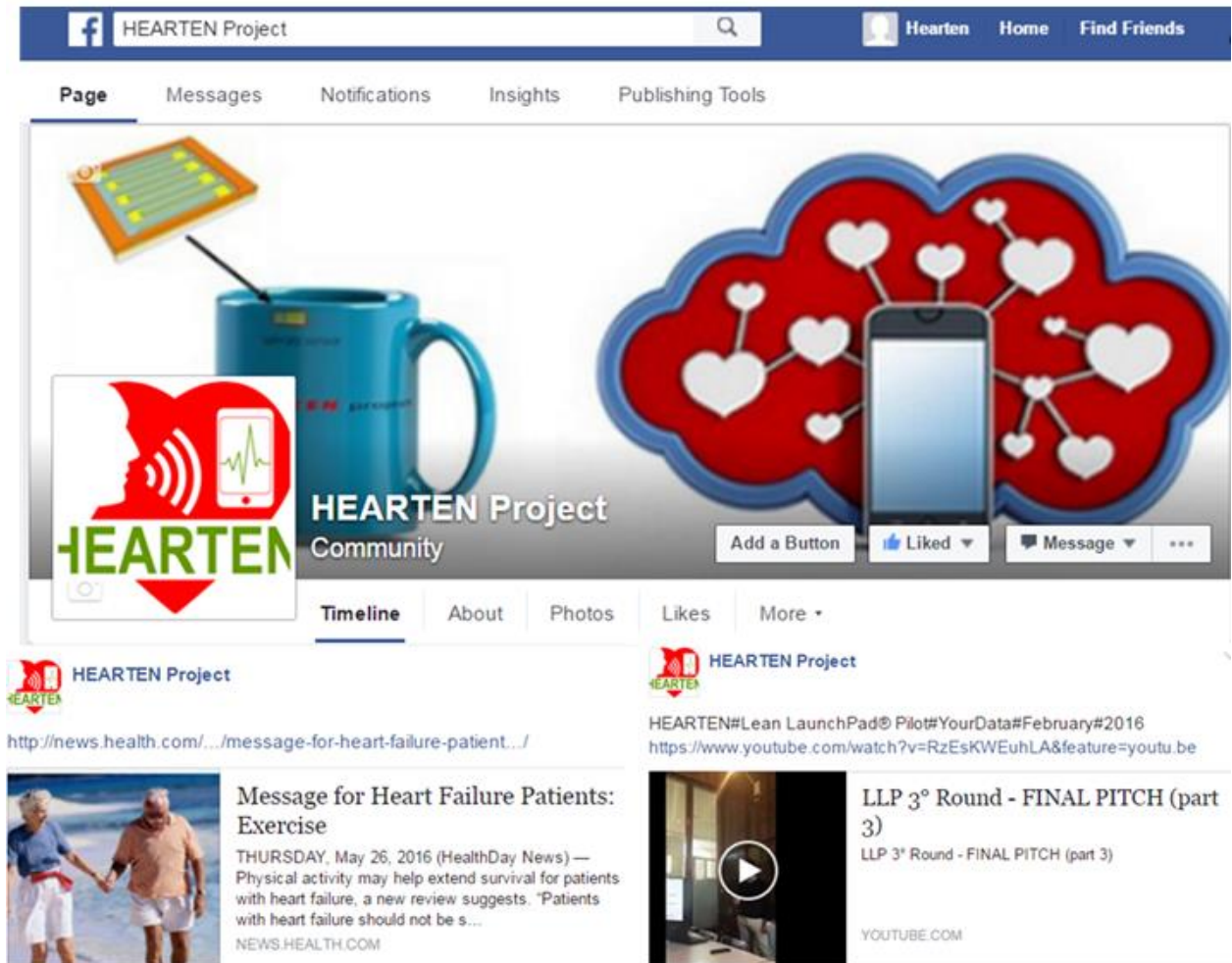


Figure 25: HEARTEN in Facebook.



Figure 26: HEARTEN in Twitter.

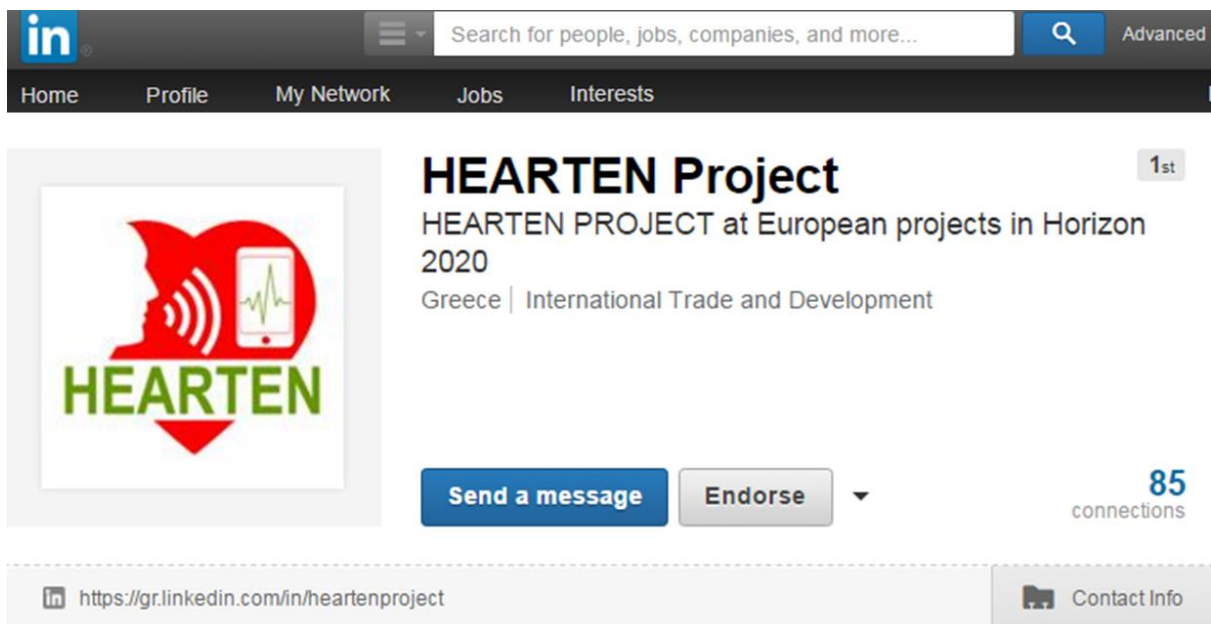


Figure 27: HEARTEN in LinkedIn.

APPENDIX

A1 Dissemination activities per partner

DISSEMINATION ACTIVITIES				
Partner(s) responsible	Actual dates	Title	Communication type	Event /Media
FORTH	Accepted May 2016-to be presented	HEARTEN: the Heart Failure Knowledge Management System	Conference	EMBC 2016 - http://embc.embs.org/2016/
SAS	Feb-16	HEARTEN - A CO-OPERATIVE MHEALTH ENVIRONMENT TARGETING ADHERENCE AND MANAGEMENT OF PATIENTS SUFFERING FROM HEART FAILURE	Presentation	Andalusian Public Health System - www.juntadeandalucia.es/proyectosinternacionales-salud/res/uploads/20160225131807-abriendo fronteras2013-2015provisional.pdf
YOUR DATA	Feb-16	HEARTEN project presentation	Presentation	Lean LaunchPad® Pilot Initiative launched by the European Commission for European researchers, new ventures and entrepreneurs in the ICT domain -(Rome at the LUISS enlabs) http://youtu.be/RzEsKWEuhLA www.europeanlaunchpad.com
UCBL	Mar-16	Boron-doped Diamond Electrodes Modified with Fe ₃ O ₄ @Au Magnetic Nanocomposites as Sensitive Platform for Detection of a Cancer Biomarker, Interleukin-8.	Journal article	Electroanalysis Journal
FORTH	Apr-16	HEARTEN project presentation	Flyer distribution	PATRAS IQ 2016 - http://www.patrasiq.gr/index.php
UCBL	Apr-16	A Flexible Electrochemical Micro Lab-on-Chip: Application to the detection of interleukin-10	Journal article	Microchimica Acta (DOI 10.1007/s00604-016-1847-y)
UCBL	Apr-16	Submicron magnetic core conducting polypyrrole polymer shell: Preparation and characterization	Journal article	Materials Science and Engineering: C, Volume 61, 1 April 2016, Pages 688-694
	42461	The evolution of mHealth interventions in Heart Failure	Conference presentation	XIV Mediterranean Conference on Medical and Biological Engineering and Computing (MEDICON 2016)
UCBL	42461	A novel EIS field effect structures coated with TESUD-PPy-PVC-dibromoaza helicene matrix for potassium ions detection	Journal article	Materials Science and Engineering: C, Volume 61, 1 April 2016, Pages 608-615
UCBL	May-16	Magnetic particles: From preparation to lab-on-a-chip, biosensors, microsystems and microfluidics applications	Journal article	Trends in Analytical Chemistry
UCBL	To be published	Preparation of gold nanoparticles and determination of their particles size via different methods	Journal article	Materials Research Bulletin, Volume 79, July 2016, Pages 97-104
UCBL	To be published	Development of a novel capacitance electrochemical biosensor based on silicon nitride for ochratoxin A detection	Journal article	Sensors and Actuators B: Chemical, Volume 234, 29 October 2016, Pages 446-452
UCBL	To be published	Electrochemical capacitive K ⁺ EMIS chemical sensor based on the dibromoaza helicene as an ionophore for potassium ions detection	Journal article	Journal Electroanalysis
UMR	Jun-16	FEV manoeuvre induced changes in breath VOC compositions: an unconventional view on lung function tests	Journal article	Scientific Reports
FORTH	under review	Predicting adherence profile of patients with heart failure through machine learning techniques	Journal article	Healthcare Technology Letters (IET) Special Issue on Mobile Health