

Project Acronym: HosmartAI
Grant Agreement number: 101016834 (H2020-DT-2020-1 – Innovation Action)
Project Full Title: Hospital Smart development based on AI



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101016834

DELIVERABLE

D1.1 – Domain Landscape

Dissemination level:	PU -Public
Type of deliverable:	R -Report
Contractual date of delivery:	30 April 2021
Deliverable leader:	José R. Villar (ITCL)
Status - version, date:	Final – v1.0, 2021-04-27
Keywords:	Pilot description, needs and challenges, ontology terms, technology, state of the play.

*This document is part of a project that has received funding from the European Union's Horizon 2020 research and innovation programme under agreement No 101016834. The content of this document reflects only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.
The document is the property of the HosmartAI consortium and shall not be distributed or reproduced without the approval of the HosmartAI Project Coordination Team. Find us at www.hosmartai.eu.*

Executive Summary

The main objective of HosmartAI is to promote an effective and efficient health care system transformation using AI technological developments and robotics. HosmartAI will introduce an AI platform that will allow for core facilities to be shared and linked composing smart services for healthcare professionals, patients, information system managers, and health organisation administrations.

A total of 24 partners are collaborating on health services and technological developments of robotics and AI for the HosmartAI project. The approach will guarantee the integration of Digital and Robot technologies in the new Healthcare environments and the possibility to analyse their benefits.

The ambitions pursued in the project by the partners focus on the following targets:

- Diagnosis revolution
- Logistic efficiency
- Treatment improvement
- Surgical support
- Assistive care

This document addresses a state of play analysis on existing Healthcare procedures, Innovative AI-based and robotics systems, methods, components and tools that can be integrated into the HosmartAI services and platform backbone infrastructure.

Being an applied AI project, most of the methods and tools will be based upon the pre-existing know-how and background knowledge that the consortium partners bring into the project, including open-source tools actively supported by the corresponding communities, as well as on in-house components and tools developed by the consortium partners.

Deliverable D1.1 represents the Domain Landscape and comes from the direct outcome of Task T1.1, documenting the needs and challenges on existing Healthcare procedures. Additionally, innovative AI-based and robotics systems, methods, components and tools, pre-existing know-how and background knowledge that cope with the mentioned needs and challenges will be made explicit.

This document is structured as follows. Firstly, the needs and challenges from each Pilot are identified and described. These needs are grouped, and a set of taxonomy terms are proposed for each group when possible (see Table 15). Secondly, the updated descriptions of the background brought to the project from each of the partners are included, specifying the needs and challenges covered or solved by the corresponding background. This second part is structured according to the tasks defined for Working Package 3.

The main contribution of this document is not only the state of the play but also the discovery of some needs and challenges that are uncovered by HosmartAI. These needs are marked in **green bold letters** in the tables within Chapter 2, mainly in Table 15.

Deliverable leader:	José R. Villar (ITCL)
Contributors:	Robert Hofsink (PHILIPS) Romanin Gianluca, Pomella Alberto Antonio (VIMAR) Pauline Loygue, Khaldoun Al Agha (GC) Iwa Stefanik, Nuno Varandas (F6S) Oksana Vilne, Gintare Marine (TGLV) Arber Baraliu, Bleron Baraliu (91) Andrej Bergauer, Vojko Flis, Nina Kobilica, Tadej Kampič (UKCM), Andrea Turolla (IRCCS) Marcel Martinez-Cossiani, Jose L. Merino (FIBHULP) Marcela Chavez, Patrick Dufлот (CHUL) Marianna Fotiadou (AHEPA) Evangelos Logaras, Giannis Dimaridis (AUTH) Christophe Chautems (ETHZ) Izidor Mlakar, Daniel Hari, Riko Šafarič, Suzana Uran (UM) Rosa Almeida, Raquel Losada (INTRAS) Philip Sotirades, Manos Georgoudakis (TMA) Alberto Navarro, Silvia González, Basam Musleh, Rodrigo Sedano (ITCL) Hans De Canck, Wim Vranken (VUB)
Reviewers:	Bojan Musil (UM) Francesca Stival (VIMAR)
Approved by:	Athanasios Poulakidas, Irene Diamantopoulou (INTRA)

Document History			
Version	Date	Contributor(s)	Description
0.1	2021-02-12	José R. Villar	Initial Draft
0.2	2021-03-19	All partners	Introduction and Section 2
0.3	2021-03-31	All partners	Section 3 and the complete document
0.4	2021-04-16	UM, VIMAR	Reviewing Process
0.5	2021-04-23	ITCL	Updated version with corrections
1.0	2021-04-27	INTRA	Final version for submission

Table of Contents

Executive Summary.....	2
Table of Contents.....	4
Table of Figures.....	6
List of Tables	6
Definitions, Acronyms and Abbreviations	7
1 Introduction	9
1.1 Project Information.....	9
1.2 Document Scope	11
1.3 Document Structure	11
2 Health Procedures, Methodologies and Technologies.....	13
2.1 Pilot #1: Development of a clinician-friendly, interpretable computer-aided diagnosis system (ICADx) to support and optimise clinical decision making in multi-specialty healthcare environment	13
2.1.1 First medical application scenario	13
2.1.2 Second medical application scenario.....	14
2.1.3 Third medical application scenario	15
2.1.4 Fourth medical application scenario	16
2.2 Pilot #2: Optimizing the use of radiotherapy.....	17
2.3 Pilot #3: Treatment Improvement with the use of innovative technologies and robotics in rehabilitation process	20
2.4 Pilot #4: Robotic Systems for minimally Invasive Operation.....	21
2.5 Pilot #5: Assistive Care in Hospital: Robotic Nurse	22
2.5.1 Clinician-Centred use	22
2.5.2 Patient-Centred use	25
2.6 Pilot #6: Assistive Care in Care Centre: Virtual Assistant	26
2.6.1 Context of intervention and usual services provision	26
2.6.2 Care and rehabilitation workflows, communication gaps and decision-making	27
2.6.3 The research, development and implementation gaps.....	27
2.7 Pilot #7: Smart Cathlab Assistant.....	31
2.7.1 Complex clinical workflow and decision making	32
2.7.2 Administrative burden	32

2.8	Pilot #8: Prognosis of cancer patients and their response to treatment combining multi-omics data	33
2.8.1	Digital health research platform	33
2.8.2	Decision support system.....	34
2.9	A taxonomy of needs	35
3	Background knowledge.....	40
3.1	Tools for Diagnosis Revolution	40
3.1.1	AI tools for medical diagnostic applications	40
3.1.2	Scenario-specific descriptions.....	41
3.1.3	Background of involved teams	42
3.2	Tools for Logistic Improvement	42
3.3	Tools for Treatment Improvement	44
3.3.1	Smart home solutions	44
3.3.2	Installation	45
3.3.3	Network and Communication.....	45
3.3.4	App View and View Wireless	46
3.3.5	Available Devices	47
3.3.6	Available Data	49
3.3.7	iPrognosis Technologies.....	50
3.4	Tools for Surgical Support.....	50
3.4.1	Clinical support	51
3.4.2	Operational efficiency and workflow.....	52
3.5	Tools for Assistive Care	52
3.5.1	Digital tools to support requirements of the in-hospital care setting (Pilot #5, Pilot #2) 53	
3.5.2	Digital tools to support requirements of the nursing setting (Pilot #6)	60
3.6	Tools for Personalised Treatment.....	65
3.6.1	Computer-aided diagnosis of medical images.....	67
3.6.2	Molecular level analysis	67
3.6.3	Digital health research platform	68
4	References	69

Table of Figures

Figure 1: Example of connected devices compared with traditional ones.	45
Figure 2: Architecture of the system.	46
Figure 3: Examples of the VIMAR App.	47
Figure 4: Example impression of stenosis segmentation in coronary vessels.....	52
Figure 5: Example impression of automated case reporting.....	52
Figure 6: Pepper’s size and Motors located on Pepper’s body allow delivery of a wide variety of conversational behaviour.	54
Figure 7: Posture estimation in two different environments: Office left, Factory right.	58
Figure 8: Recreating communicative acts by a Robot (iCub simulator) and embodied Conversational Agent.....	59
Figure 9: E-pokratis screenshot from the doctor's account.	61
Figure 10: Screenshot of E-pokratis showing the past cases for a doctor.....	61
Figure 11: Main screenshots from the smartphone App.....	62
Figure 12: Overview of tools for personalised treatment covered by Pilot #8.	67

List of Tables

Table 1: The HosmartAI consortium.	10
Table 2: Pilot #1. Needs and Challenges for the first medical application scenario.	14
Table 3: Pilot #1. Needs and Challenges for the second medical application scenario.	15
Table 4: Pilot #1. Needs and Challenges for the third medical application scenario.	16
Table 5: Pilot #1. Needs and Challenges for the fourth medical application scenario.....	17
Table 6: Pilot #2. Needs and Challenges.....	18
Table 7: Pilot #3. Needs and Challenges.....	20
Table 8: Pilot #4. Needs and Challenges.....	22
Table 9: Pilot #5. Needs and Challenges for Clinicians-Centre used.	23
Table 10: Pilot #5. Needs and Challenges for Patient-Centre used.....	25
Table 11: Pilot #6. Needs and Challenges.....	28
Table 12: Pilot #7. Needs and Challenges.....	32
Table 13: Pilot #8. Needs and Challenges for the digital health research platform.....	33
Table 14: Pilot #8. Needs and Challenges for the decision support system.....	34
Table 15: Taxonomy of the needs and challenges.....	36
Table 16: Catalog of available devices.....	47
Table 17: Data generated per device.....	49