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DELIVERABLE

D6.6 – Certification, Training and alignment actions and material

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Executive Summary

The importance of training health care professionals, physicians, nurses, and allied health sciences professionals in the art, skill, and science of medical informatics has never been greater. To meet the challenges ahead of us, we must rapidly train healthcare professionals and workers in health informatics. In addition to buying hardware and software, our health care systems need to support this continuous education and training. It is now mandatory as informatics applications incorporate state-of-the-art technologies such as AI. The HosmartAI project, anticipating this requirement, has developed and incorporated a certification programme in health informatics for all project staff and use case centres.

Within the project, T6.4 was responsible for EFMI's (European Federation for Health Informatics) certification of healthcare professionals. Furthermore, this task involved staff training, education, and alignment with existing practices. We apply Donald Kirkpatrick's well-known educational and training approach: Perform a training needs assessment, develop learning objectives, design, and develop training materials, implement the training, and evaluate the training. The contents of the medical informatics curriculum are based on adapting the recommendations of the International Medical Informatics Association (IMIA) to meet the specific needs of the project. We apply a step-by-step approach that encompasses three dimensions: the development of the training activities, the ongoing quality assurance of the educational process, and the public health impact. We applied the self-regulation concept within this framework, conducting qualitative, semi-structured interviews using questionnaires with the participants to evaluate the training activities.

In order to establish certification procedures for particular skills and competencies in the field of Biomedical and Health Informatics (BMHI), several key elements are necessary. These include defining the objective, identifying the target audience, designing a curriculum that addresses the audience's specific needs and scope, and implementing a delivery platform that ensures the procedures are objective and high quality. The EFMI AC2 methodology in developing certification curriculum in Health Informatics, is aligned closely to the Kern et al. framework, and involves the following steps: (I) Training needs assessment; (II) Situation analysis; (III) Curriculum development; (IV) Implementation (both through teaching and learning opportunities and assessment); (V) Evaluation and review. Applying the previously described methodology, the Consortium partners, in cooperation with the EFMI AC2 team, developed the certification courseware material structured as follows: Chapter 1. Biomedical and health informatics: an Introduction; Chapter 2. Electronic Health Records and Security; Chapter 3. Clinical Decision Support; Chapter 4. Telemedicine and Telehealth; Chapter 5. Artificial Intelligence. Natural Language Processing; Chapter 6. Ethical Issues in Health Informatics. Safety, Quality, and FAIR principles. The means of presenting the material were transparencies, pdf files, and videos.

The implementation process began with a call to potential participants from the use case centres and partner institutions. The certification process received overwhelming acceptance, leading to the registration of 40 participants for the program. Following their self-study, all participants took the quiz examinations, and 38 of them successfully passed, earning

their certification. During the project's final meeting, a humble ceremony provided certification awards to all successful trainees.

Several questionnaires were prepared to monitor the entire process of training. From the beginning to collect the user needs, assisting the courseware development team to trim the contents based on the answers of the professionals, questionnaires to collect procedural information to fit the implementation phase of the certification; questionnaires to evaluate the performance of the trainees based on programme standards, questionnaires to evaluate the contents of the programme according to the trainees expectations; and, finally, questionnaires to evaluate the overall performance of the certification programme, and the expected impact that the programme may have to the trainees professional work.

The certification process's measurable outcomes highlight the critical role of continuous and lifelong training for healthcare professionals. This is crucial for the successful implementation of informatics and AI applications, as well as for enhancing performance and facilitating the digitalization of healthcare services. This is because these professionals have acquired the necessary knowledge and skills in health informatics, as mandated by international organizations such as WHO and IMIA. To achieve this goal, the HosmartAI certification process has been aligned with international requirements.

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Definitions, Acronyms and Abbreviations

Acronym/ Abbreviation	Title
DoA	Description of Action
KPI	Key Performance Indicator
PC	Project Coordinator
PU	Public
WP	Work Package
T&C	Training and Certification
ATC	Accreditation Training Certification
EFMI AC2	European Federation for Medical Informatics Accreditation Committee
BMHI	Biomedical and Health Informatics
HIT	Health Information Technology
ICT	Information and Communication Technology
GCC	Gulf Cooperation Council

Term	Definition
Certification program	Activity like a course that ends with a certificate that proves a certain skill, qualification, or professional area
Training	The process of learning the skills that you need for a particular job or activity
Beneficiary	EC term used to designate the legal entity which has signed the Grant Agreement. This term is often substituted by the common language term 'partner'.
Consortium	Group of beneficiaries that have signed the Consortium Agreement and the Grant Agreement (either directly as Coordinator or by accession through the Form A).
Consortium Agreement	Contractual document signed by all the beneficiaries (and not the EC), explaining how the Consortium is managed and works together.
Deliverable Leader	Responsible for ensuring that the content of the deliverable meets the required expectations, both from a contractual point of view and in terms of usage within the project. Is also responsible for ensuring that the deliverable follows the deliverable process and is delivered on time.
Description of Action	Annex 1 to the Grant Agreement. It contains information on the work packages, deliverables, milestones, resources, and costs of the beneficiaries, as well as a text with a detailed description of the action. The DoA is made of Part A (structured data collected in web forms and workplan tables) and Part B (text document describing the action elements).
Grant Agreement	Contractual document which defines the contractual scope of the HosmartAI project. It is signed between the EC and the beneficiaries.

1 Introduction

1.1 Project information

VISION

The HosmartAI vision is a strong, efficient, sustainable and resilient European **Healthcare system** benefiting from the capacities to generate impact of the technology European Stakeholders (SMEs, Research centres, Digital Hubs and Universities).

MISSION

The HosmartAI mission is to guarantee the **integration** of Digital and Robot technologies in new Healthcare environments and the possibility to analyse their benefits by providing an **environment** where digital health care tool providers will be able to design and develop AI solutions as well as a space for the instantiation and deployment of an AI solutions.

HosmartAI will create a common open Integration **Platform** with the necessary tools to facilitate and measure the benefits of integrating digital technologies (robotics and AI) in the healthcare system.

A central **hub** will offer multifaceted lasting functionalities (Marketplace, Co-creation space, Benchmarking) to healthcare stakeholders, combined with a collection of methods, tools and solutions to integrate and deploy AI-enabled solutions. The **Benchmarking** tool will promote the adoption in new settings, while enabling a meeting place for technology providers and end-users.

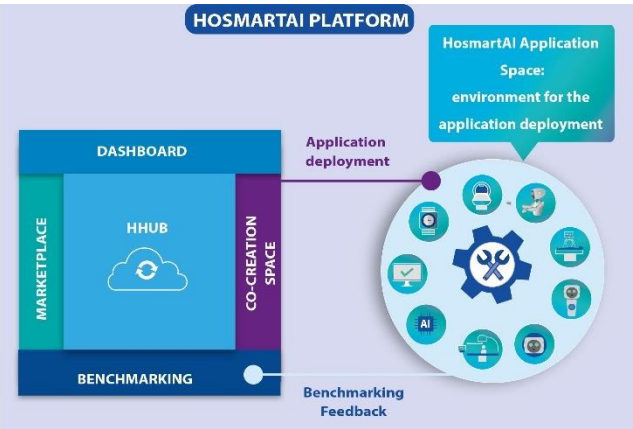


Figure 1: HosmartAI platform.

Eight Large-Scale Pilots will implement and evaluate improvements in medical diagnosis, surgical interventions, prevention and treatment of diseases, and support for rehabilitation and long-term care in several Hospital and care settings. The project will target different **medical** aspects or manifestations such as Cancer (Pilot #1, #2 and #8); Gastrointestinal (GI) disorders (Pilot #1); Cardiovascular diseases (Pilot #1, #4, #5 and #7); Thoracic Disorders (Pilot #5);

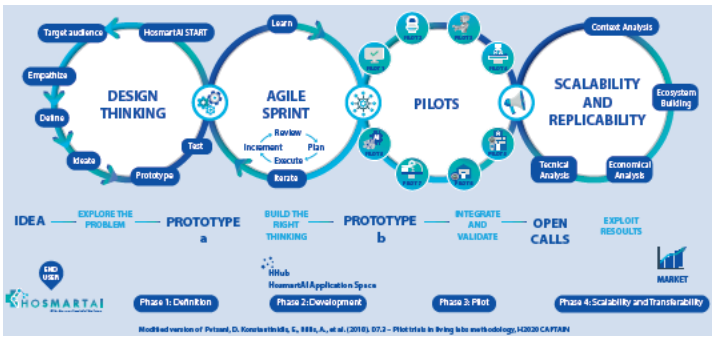


Figure 2: Methodology .

Neurological diseases (Pilot #3); Elderly Care and Neuropsychological Rehabilitation (Pilot #6); Fetal Growth Restriction (FGR) and Prematurity (Pilot #1).

To ensure a user-centred approach, harmonization in the process (e.g. regarding ethical aspects, standardization, and robustness both from a technical and social and healthcare perspective), the **living lab** methodology will be employed. HosmartAI will identify the appropriate instruments **(KPI)** that measure efficiency without undermining access or quality of care. Liaison and co-operation activities with relevant stakeholders and **open calls** will enable ecosystem building and industrial clustering.

HosmartAI brings together a **consortium** of leading organizations (3 large enterprises, 8 SMEs, 5 hospitals, 4 universities, 2 research centres, and 2 associations – see Table 1) along with several more committed organizations (Letters of Support provided).

Table 1: The HosmartAI consortium.

Number[1]	Name	Short name
1 (CO)	INTRASOFT INTERNATIONAL SA	**INTRA**
1.1 (TP)	INTRASOFT INTERNATIONAL SA	**INTRA-LU**
2	PHILIPS MEDICAL SYSTEMS NEDERLAND BV	**PHILIPS**
3	VIMAR SPA	**VIMAR**
4	GREEN COMMUNICATIONS SAS	**GC**
5	TELEMATIC MEDICAL APPLICATIONS EMPORIA KAI ANAPTIXI PROIONTON TILIATRIKIS MONOPROSOPIKI ETAIRIA PERIORISMENIS EYTHINIS	**TMA**
6	ECLEXYS SAGL	**EXYS**
7	F6S NETWORK IRELAND LIMITED	**F6S**
7.1 (TP)	F6S NETWORK LIMITED	**F6S-UK**
8	PHARMECONS EASY ACCESS LTD	**PhE**
9	TERAGLOBUS LATVIA SIA	**TGLV**
10	NINETY ONE GMBH	**91**
11	EIT HEALTH GERMANY GMBH	**EIT**
12	UNIVERZITETNI KLINICNI CENTER MARIBOR	**UKCM**
13	SAN CAMILLO IRCCS SRL	**IRCCS**
14	SERVICIO MADRILENO DE SALUD	**SERMAS**
14.1 (TP)	FUNDACION PARA LA INVESTIGACION BIOMEDICA DEL HOSPITAL UNIVERSIATRIO LA PAZ	**FIBHULP**
15	CENTRE HOSPITALIER UNIVERSITAIRE DE LIEGE	**CHUL**
16	PANEPISTIMIAKO GENIKO NOSOKOMEIO THESSALONIKIS AXEPA	**AHEPA**
17	VRIJE UNIVERSITEIT BRUSSEL	**VUB**
18	ARISTOTELIO PANEPISTIMIO THESSALONIKIS	**AUTH**
19	EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH	**ETHZ**
20	UNIVERZA V MARIBORU	**UM**
21	INSTITUTO TECNOLÓGICO DE CASTILLA Y LEON	**ITCL**
22	FUNDACION INTRAS	**INTRAS**
23	ASSOCIATION EUROPEAN FEDERATION FORMEDICAL INFORMATICS	**EFMI**

[1] CO: Coordinator. TP: linked third party.

24	FEDERATION EUROPEENNE DES HOPITAUX ET DES SOINS DE SANTE	**HOPE**

1.2 Purpose, context and scope

The Certification, Training and alignment actions and material is an activity included in WP6/T6.4 in the HosmartAI project.

Certification, Training Activities Report aims to:

- Describe the need for the training and certification activities related to HosmartAI
- Present the activities developed to reach the KPIs
- Collect feedback from participants that expanded their knowledge, gain new skills, and raise professionalism in the currently new dynamic work environment

1.3 Structure and Content

The document is divided into the following chapters:

- Certification and training overview
  - Impact
  - Certification & Training objectives
  - Certification & Training plan
  - Certification & Training monitoring
- Certification & Training results
- Certification & Training support summary
  - International/European regulation
  - Methodology
  - EFMI AC2 as professional corpus for Certification activities
- Certification, Training and alignment actions and material mechanisms – report
  - Organization of initial feedback from partners
  - Development of training materials
  - EFMI AC2 review and feedback
  - Development of evaluation support
  - Certification
- Key Performance Indicators
- Conclusions

2 Certification & Training - overview

2.1 Impact

The certification program involved activities of training and evaluation that ended with a certificate that proves a medium level of skills and validates qualification in Health Informatics. 11 partners from the 23 applied for TC activities, resulting in a participation rate of 47%. Certification proved that participants are dedicated to their careers and are willing to invest time and effort into learning new things. For individuals, certification programs can provide a sense of accomplishment, completion, and pride and improve job prospects and earnings potential. For businesses, certification programs can help ensure employees have the necessary skills and foundational knowledge to do their jobs correctly.

2.2 Certification & Training objectives

Task 6.4 Certification, Staff training & education and alignment with existing practice (M19-M41, Leader: EFMI): T6.4 was responsible for the certification of the Healthcare professionals by the European Federation for Medical Informatics. This task included staff training, education, and alignment with existing practice. The Donald Kirkpatrick approach was applied: Perform a Training Needs Assessment, Develop Learning Objectives, Design and Develop Training Materials, Implement the Training and Evaluate the Training. The contents related to Medical Informatics were based on adapting the Recommendations of the International Medical Informatics Association to the needs of the project. A stepwise approach consisting of three dimensions including the development of the training activities, the ongoing quality assurance of the educational process and the public health promotion results was considered. Participants answered to questionnaires in order to gather the perception of the applicants related to the training activities.

Partners in T6.4: UKCM, IRCCS, FIBHULP, CHUL, AHEPA, VUB

Univerzitetni klinicni center Maribor (UKCM), established in LJUBLJANSKA ULICA 5,

MARIBOR 2000, Slovenia

SAN CAMILLO IRCCS S.R.L. (IRCCS), established in Via Alberoni 70, VENEZIA 30126, Italy

FUNDACION PARA LA INVESTIGACION BIOMEDICA DEL HOSPITAL UNIVERSIATRIO LA PAZ (FIBHULP), affiliated or linked to SERMAS

CENTRE HOSPITALIER UNIVERSITAIRE DE LIEGE (CHUL), established in Sart Tilman B35, LIEGE 4000, Belgium

UNIVERSITY GENERAL HOSPITAL OF THESSALONIKI AHEPA (AHEPA), established in 1, STILPONOS KIRIAKIDI, THESSALONIKI 546 36, Greece

VRIJE UNIVERSITEIT BRUSSEL (VUB), established in PLEINLAAN 2, BRUSSEL 1050, Belgium

ARISTOTELIO PANEPISTIMIO THESSALONIKIS (AUTH), established in KEDEA BUILDING, TRITIS SEPTEMVRIOU, ARISTOTLE UNIV CAMPUS, THESSALONIKI 54636, Greece

2.3 Certification & Training plan

Activity: Month

- Review of project activities to focus on needed topics (M19-M23)
- Perform a Training Needs Assessment: M24-M29
  Questionnaires development and processing/Analysing answers and decide activities
- Develop Learning Objectives: M29-M31
- Design and Develop Training Materials/review/: M32-M36:
  (6 lectures)
- Implement the Training: M35-M37
- Evaluation/review M38-M39
- Perception of the Training & Certification: M40
- Deliverable D6.6: M40-M41
- Meetings: M23-M41
- Activities support: M19-M41

Timeline for training:

- **November 2023 - First training module online - Topics 1-3**
- **Plenary end of November - Second training module f2f - Topics 4-6**
- **December – February - Continuous communication - Topics 1-6**

3 Certification & Training results

The results of the activities during T6.4 task were related to both activities. Training was performed for 34 participants from 11 partners involved in the activities of the 8 pilots. The educational material was organized in 6 chapters with current important topics related to HosmartAI focus. The certification involved 34 participants. 32 passed the certification with grades between a maximum of 60 points and a minimum of 30. Graphical results are presented in Appendix E and Section 5.5.

4 Certification & Training support summary

4.1 International/European regulation

The World Health Organisation has emphasised the growing disparity between the current and necessary health workforce, forecasting a worldwide deficit of 18 million workers in order to meet the health-related sustainable development objectives by 2030. The healthcare landscape in many nations is undergoing substantial transformation, characterised by shifting population health requirements, the increasing importance of universal health coverage, the need for clinicians to perform multiple tasks, and the development of new care delivery models. Consequently, ensuring the readiness of a skilled workforce to provide secure and efficient services is of utmost importance. The growing use of digital health technology has the capability to tackle these rising difficulties while simultaneously enhancing person-centered care and the capacity of the health staff. Several nations have implemented evaluations to tackle the issue of how they train a technologically proficient healthcare personnel. The rather recent Topol review (4) predicts that 90% of healthcare jobs in the United Kingdom (UK) will require digital skills to some degree in the next 20 years. This will further exacerbate the already significant difficulties in recruiting staff in an environment that is undergoing extensive digital transformation. High-quality education in Biomedical and Health Informatics (BMHI) will be necessary to enhance a workforce that is prepared to embrace and adjust to new technologies in order to enhance healthcare results.

The current realisation of BMHI's potential is still limited. Although there are demonstrated benefits and expectations, there are still limitations in the practical use of BMHI. The absence of international standards implementation and semantic compatibility hinder patient-centric care and act as barriers to fully digitalized workflows. In addition, physicians frequently view current clinical information systems as burdensome and disruptive rather than helpful in their work. Further study is still needed to expand the existing data on the benefits and limitations of Health Information Technology (HIT) and to utilise this evidence for the continued development and implementation of HIT in clinical practice.

The state of affairs in biomedical research is analogous. Biomedical research necessitates the integration and/or connection of data from a growing range of diverse modalities. BMHI facilitates the ability to get, control, and present this data, and hence plays a crucial part in healthcare, biomedical, and clinical research that relies on data.

In many nations, a significant obstacle that persists in 2022 is the absence of proper identification and training of the BMHI staff, which is essential for the efficient implementation and upkeep of ICT systems. Australia has addressed the absence of empirical evidence on the BMHI workforce by implementing a triennial employment census. The 2018 data indicated that the majority of workers in the field lack any formal education in BMHI. Approximately 25% of individuals in this field have a secondary health-related role (5). Many of them are in the early stages of their career in the field of Behavioural Medicine and Health Informatics (BMHI). The wide variety of job titles and functions within this workforce demonstrates the diversity of roles available. The countries of the Gulf Cooperation Council

(GCC) have also encountered a deficiency in defining the workforce. As a solution, they have implemented a 'career pathway skills model' which involves offering training and organising an annual conference for various healthcare professionals. The aim is to establish long-lasting careers in the field of Biomedical and Health Informatics (BMHI).

A further complication arises from the diverse interpretations of the domain of BMHI. The area faces challenges in reaching a consensus over the appropriate adjective to use before the term "informatics" (such as medical, biomedical, and/or health) and in determining whether a professional should be referred to as an "informaticist" or an "informatician" (this study adopts the latter term). In many countries, the use of digital health has become increasingly popular, leading to the complete replacement of the term informatics. Nevertheless, we shall consistently employ the acronym BMHI throughout. Difficulties can arise in distinguishing the boundary between pure Information and Communication Technology (ICT) and Biomedical and Health Informatics (BMHI). For instance, the person responsible for installing software on a desktop computer in a hospital may not require formal training in Biomedical Health Informatics (BMHI), although the Chief Information Officer and project leaders undoubtedly do. As a result of this differentiation, there were demands almost twenty years ago for BMHI to be recognised as a professional field and to possess the characteristics of a profession, including a clearly defined set of skills, certification of suitability for practice, a shared professional identity, a lifelong dedication, and a code of ethics.

The educational recommendations serve four main purposes: firstly, to assist educators in creating BMHI curricula for various education levels; secondly, to determine the necessary skills and competencies for healthcare professionals and other individuals in the BMHI field, ensuring their ability to support BMHI development and implementation in healthcare; thirdly, to provide evaluators of academic BMHI programmes with a tool to assess and accredit the quality of these programmes; and finally, to e

Development of the BMHI Curriculum

In order to develop BMHI programmes or courses, it is necessary to have a clear curriculum objective, defined learning outcomes, content that is matched with the required skills and competences, a description of how the programme will be implemented, resources and tools to facilitate programme delivery, and a comprehensive assessment and quality assurance procedure.

BMHI Workforce Certification

In order to establish certification procedures for particular skills and competencies in the field of Biomedical and Health Informatics (BMHI), several key elements are necessary. These include defining the objective, identifying the target audience, designing a curriculum that addresses the specific needs and scope of the audience, and implementing a delivery platform that ensures the procedures are objective and of high quality.

Accreditation

In the past ten years, there has been a rise in professional credentialing programmes that are supported by specific regions or countries. These programmes are similar to academic degree programmes but focus on building competence in the field of BMHI (Biomedical and Health Informatics). They also provide formal recognition for individuals who have both work experience and expertise in this field. The conventional path to achieve this form of credentialing has typically involved gaining work experience, participating in a self-study programme, and passing an examination. Individuals will have initially obtained a formal university degree in a field related to or unrelated to BMHI.

The previous edition of BMHI education recommendations indicated that advanced courses in BMHI would be beneficial only if there were existing or emerging employment opportunities and job descriptions in the sector. Globally, there is a lack of mandatory qualifications or certificates for professional employment in the subject of BMHI. BMHI programmes and specialisations are now available in various fields, including health information management, standards, clinical informatics, data science, human aspects, artificial intelligence, and others. The professional certifications of individuals who have completed a BMHI programme are now being acknowledged as crucial credentials that demonstrate their experience in the field of BMHI. The European Federation for Medical Informatics (EFMI) has recently launched an effort and developed a certification process for Biomedical Health Informatics (BMHI).

There are multiple BMHI certificates available for nurses, physicians, and other healthcare professionals, both clinical and non-clinical. These are frequently overlooked by national professional organisations that offer a procedure that meets the standards for certification programme quality as established by national or international programme accreditation criteria. Certifications are optional endeavours undertaken by individuals to showcase their proficiency and authority in the field of Biomedical Health Informatics (BMHI). However, with this acknowledgment of being a leader, there also comes the responsibility to consistently possess the knowledge and necessary abilities to do BMHI at the utmost level of proficiency. Therefore, individuals who possess certificates are required to make use of chances such as ongoing medical education, periodic high-stakes exams to showcase their expertise, and continuous self-assessment activities. Individuals who possess a certification in a BMHI specialty are required to consistently operate at the highest level of their specialty. This entails ongoing study and the consistent display of knowledge. A significant portion of the BMHI workforce consists of individuals who have backgrounds in healthcare professions, such as medicine and nursing. These individuals may retain their professional qualifications, particularly if their job involves providing direct care to patients.

4.2 Methodology

EFMI AC2 committee (https://efmi.org/accreditation-and-certification/) aims to achieve standardisation of education and training in Biomedical and Health Informatics (BMHI) across

Europe, quality control for all aspects of training, free movement of trainees across centres and nations and the delivery of the best BMHI education.

The AC2 methodology in developing certification curriculum in Health Informatics, is aligned closely to the Kern et al. framework, and involves the following steps:

(I) Training needs assessment;

(II) Situation analysis;

(III) Curriculum development;

(IV) Implementation (both through teaching and learning opportunities and assessment);

(V) Evaluation and review.

4.2.1 (I) Assessment of the training need

Assessment of the training need, i.e., "needs assessment" focuses on the "desired results" or on the "gap" that exists in current performance/delivery. The projects come into place because of needs assessment, which explains why it is necessary to cover a certain topic and how the project will meet the educational need. The logic and rationale for the project is defined in terms of the "gap" or the "desired results". The assessment needs are defined bringing together all stakeholders with different backgrounds from developers to clinicians.

4.2.2 (II) Situation analysis.

The first phase is to analyse the current situation: the how, what, where, of current training been offered. Situational analysis is focused on the local situation within different sites; and it focuses on the activities required to affect the local situation. It evaluates the performance of activities and proposes a standard that can be applied to address the "gap". Based on this first step, the statement of intent is defined, outlining project objectives and scope including target audience and organisation of training.

4.2.3 (III) Curriculum development

The first step is to define "what" to learn; a list of topics, the syllabus, and then to specify "how" to learn and teach those topics, the curriculum. Figure 3 shows the different curricula developed through this methodology.

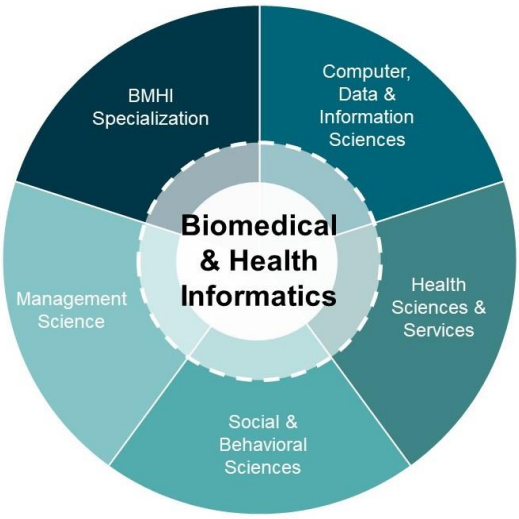


Figure 3: BMHI Knowledge Domains (according to IMIA recommendations published by IJMI (2022).

Syllabus—topic selection

The Delphi technique consensus-based method is used to define the programme content. Delphi is a "group communication process" that focuses on gathering information from a panel of experts, aiming to reach a convergence of opinion regarding a particular issue or set of issues (2). The consensus rate is agreed upon before the first round and is usually 80%, even though there is not any agreed proportion in the literature.

In the ERS projects, a modified Delphi technique is used, comprising usually of three rounds. During Delphi rounds, every participant works through a questionnaire (online survey tool: Survey Monkey) which is returned to the ERS Office; the results are collected, edited and presented to the task force members for more detailed discussions. For the second round, only the respondents of the first round are invited to participate. The Delphi rounds are phased in three different stages:

(I) A qualitative round involving all task force members is achieved through a facilitated focus group discussion face-to-face. A final review is done by the chair of the project for approving the syllabus draft before starting the survey;

(II) A semi-qualitative round with the task force members and chair of the project to approve the survey in the online environment;

(III) A quantitative round involving a large group of stakeholders including national experts in answering the online questionnaire. The data collection takes about six to seven weeks.

In Delphi studies, consensus is considered only a necessary (but not sufficient) condition for agreement concerning the inclusion of items. The iteration of rounds is required to establish the stability dimension of agreement.

Curriculum

Once the syllabus is defined, the curriculum matrix can be completed by the task force members. The curriculum expands on the syllabus content and specifies for each item:

- Learning outcomes that the target audience should acquire, which are divided into three domains: knowledge (cognitive skills), skills (psychomotor skills) and attitudes (affective skills).). The conditions under which the behaviour must be done and the standards for successful completion of training must be stated as well;
- Level(s) of assessment based on IMIA' recommendations on educational levels, which has to be assigned in alignment with the learning outcomes;
- Assessment methods that are deemed fit for purpose which is essential to the validity of assessments and to predict whether a trainee is competent to practice; Different assessment instruments are used depending the level(s) of assessment defined and on overall goals of training, including online Multiple Choice Questions (MCQ;
- Teaching and learning activities, which constitute non-work-based learning (self-directed learning: formulation of own learning goals and identification of material resources for learning), formal learning (participate in a skills-based course or attend meetings for formal training in specific areas), learning with other healthcare professionals (participation in interdisciplinary courses).

4.2.4 (IV) Implementation

Planning and implementation of curricula involves the explicit organisation of each of the components within the curriculum and how they should come together. The design of the curriculum using a modular approach allows experts to follow different educational sessions to complete one full module using a blended learning approach. ERS has prioritized some modules in the curricula developed for implementation so far.

4.2.5 (V) Evaluation

Any educational programme needs to be monitored and evaluated to ensure that delivery is taking place as planned and in line with the prescribed learning outcomes. The EFMI AC2 certification curriculum design includes an element for evaluation through distribution of questionnaire to the trainees. Items or modules implemented by EFMI AC2 through training programmes and courses include elements of evaluation by participants.

4.3 Curriculum

Applying the previously described methodology the Consortium partners in cooperation with the EFMI AC2 team developed as follows.

Chapter 1. Biomedical and health informatics: an Introduction

Contents:

- Objectives
- Standard terminology
- Associated Terms
- Biomedicine as a Science of Information

- Human Computer Interaction
- What is Multimodal Interaction?
- Types of interaction
- VR in healthcare
- References and additional readings

Objectives:

- Understanding the field of biomedical and health informatics (BMHI) or health informatics (HI)
- What improves the biomedical technology and Informatics?
- The chapter covers introductory required knowledge, abilities, and competences necessary in BMHI for those who utilize informatics in their work as healthcare professional workforce.

Chapter 2. Electronic Health Records and Security

Contents:

- Objectives
- Understanding data, information, knowledge and wisdom
- From where do medical data for a patient originate?
- Uses of clinical data
- Modern clinical data
- Clinical data
- Problem-Oriented Medical Record (POMR) Approach
- Social Determinants of Health (SDOH)
- Challenges with computerized data input
- Clinical data reusability and decrease ambiguity
- Challenges with Coded Data in Biomedical and health informatics
- Clinical Data Transformation and stewardship
- Clinical Data Challenges in special population
- Clinician's Dilemma: Narrative vs. Structured Data
- Orientation of Medical Data
- Potential HER advantages
- IOM's report for EHR
- EHR data ecosystem
- Navigate the HER system
- Patient data ownership and control
- The future vision of EHR
- Information Retrieval (Search)
- Knowledge-based information in health and biomedicine
- Information Needs and Seeking
- Challenges for Knowledge – Based Information

- Health information privacy and security
- Information privacy and security–definitions
- Achieving health information privacy and security
- Privacy–Security & Trustworthiness
- References and additional readings

Objectives:

- Presenting general information related to Electronic Health Record (EHR)– background, current outlook and some examples
- Describing how patients interact with the HER via their personal health record (PHR).

Chapter 3. Clinical Decision Support

Contents

- Objectives
- Introduction
- Definitions and scope
- Rationale
- CDS Technologies
  – Knowledge acquisition
  – Knowledge Access
  – Knowledge Access – Infobutton
  – Inferencing mechanism
  – Knowledge-Based Interventions
- Role of standards in CDS
- CDS – Specific standards
- Infrastructure Standards
- Conclusions
- Additional readings

Objectives:

- To understand what clinical decision support is and explain its scope with examples
- To identify key features of computer-based clinical decision support systems and the standards that can facilitate their implementation.
- To integrate clinical decision support technology into an overall program for achieving health care organization goals using clinical decision support.

Chapter 4. Telemedicine and Telehealth

Contents

- Definitions of key terms.
- Evaluation of telehealth and telemedicine.

- Advancements.
- Key technologies.
- Benefits and barriers.
- Education and training.
- Applications.

Objective

- This presentation is aimed at a diverse group of individuals with varying levels of expertise who are interested in familiarizing themselves with concepts related to telehealth and telemedicine.

Chapter 5. Artificial Intelligence. Natural Language Processing

Contents

- Objectives
- AI in Healthcare – what is and how it works
- Neural networks – AI algorithms
- Algorithms/Techniques for AI applications
- Market review & trends - applying AI in healthcare
- AI in HealthCare – status/motivation
- Clinicians will be replaced by AI ?!
- AI in healthcare – view & challenges
- AI in Nursing – status
- Virtual Nursing Assistants
- AI & Workflow and Administrative Tasks
- AI & Workflow and Administrative Tasks – examples
- Explainable Artificial Intelligence (XAI)
- XAI connected notions
- XAI – who benefits?
- Interpretability vs Explainability
- Advantages of AI in healthcare – a summary
- Challenges of AI in healthcare – a summary
- Standards & legislation
- AI regulatory timeline globally
- World Health Organization and AI
- World Health Organization and AI & EU
- Examples
- Natural Language Processing;
- Natural Language Processing – algorithms
- Natural Language Processing – techniques
- Natural Language Processing – use
- Example - comparison of NLP techniques

Objectives

- An introduction to the fields of AI and NLP, with examples
- Uses of AI and NLP to improve public health, healthcare, individual health, clinical environment, administrative tasks
- Motivation of using AI and NLP in healthcare

Chapter 6. Ethical Issues in Health Informatics. Safety, Quality, and FAIR principles

Contents

- Objectives
- Introduction
- Informatics ethics
- Essential ethical issues.
- Difficulties in the digital world of applying medical ethics
- Issues Regarding the Textual Object Framework
- Issues with Human Subject Framework
- Transferring responsibility in ethics
- Text contact between patients and caregivers
- Material from Electronic Files and Databases being Anonymized
- Artificial Intelligence and Ethics
- FAIR Principles - Objectives of the Section
- FAIR principles
- FORCE11 - FAIR Data Guiding Principles
- Relevant aspects of metadata
- The value of the FAIR principles for the AI adoption
- Research Data Alliance (RDA)
- The RDA FAIR Data Maturity Model
- RDA FAIR Data Maturity Model Framework
- The FAIR data maturity model of HosmartAI pilots data.
- Drivers that provide some level of FAIR maturity to the HosmartAI pilot data: FHIR Server and MIMO Ontology (task 2.1)
- Some examples of how the use of the FHIR server provides fulfilment of RDA FAIR Data Maturity Model indicators
- Some examples of how the use of the FHIR server and the contribution of the pilots provide fulfilment of RDA FAIR Data Maturity Model indicators
- RDA FAIR Data Maturity Model indicators to be achieved by pilots supported on the FHIR server
- Additional readings

Objectives

- The importance of IMIA Code of Ethics for Health Information Professionals provisions
- The ways in which ethics, law, culture, and society are intertwined.

- The various ethical perspectives held in various nations.
- A list of the most important ethical guidelines for health informatics
- Health informatics ethics are applied to relevant health informatics research
- The primary and main areas of concern with artificial intelligence and ethics.

4.4 EFMI AC2

Biomedical and Health Informatics is a multidisciplinary and interdisciplinary field of study constituting the intersection of information science, computer science, and healthcare, and it may be also considered as a facilitator of interprofessionalism in the healthcare domain.

Quality of education is of paramount importance, ensuring adequate knowledge and skills, and its monitoring should be applied from the very beginning of education, developing a quality pathway towards a capacity building of professionals in Biomedical and Health Informatics.

Scope of EFMI AC2 and Coordination

EFMI AC2 Scope: "The promotion and monitoring of implementation of quality standards in Education across the Biomedical and Health Informatics community in Europe"

The EFMI Board has appointed a Committee, the EFMI AC2 Committee to coordinate the activities of Accreditation and Certification. The committee is chaired by Professor Emeritus John Mantas, PhD, FEFMI, FACMI, FIAHSI.

EFMI Accreditation and Certification

Accreditation is a diligent evaluation and monitoring peer review process assuring that educational programmes and institutions meet academic standards and operational integrity and quality.

The EFMI accreditation:

- provides European added value to the programmes,
- is supportive to the cross-national mobility (such as Erasmus +),
- is focused on meeting the scientific requirements and international standards in Biomedical and Health Informatics
- it is complimentary to the required national accreditations processes
- facilitates the Certification of professionals who have completed their academic careers in an EFMI AC2 Accredited program.

Accreditation

- The evaluation criteria are based on the Dublin Descriptors, as they have been presented and applied at all academic levels (Bachelor, Master, and Doctoral degrees).
- Site-visit Panel Members' - Code of Conduct
- Declaration of No Conflict of Interest and Confidentiality (to be submitted prior to the assessment of the programme)

Certification

- Certification is a credentialing process that demonstrates and honours qualifications that an individual can perform a specific professional role, or a set of tasks.
- Certification in Health Informatics is a requirement for many professionals in many clinical institutions in a number of countries.
- Specifically Clinical Health Informatics is a special concern, as many professionals who are using or implementing health information systems or applications or instrumentation in their professional life.
- Even those professionals having acquired earlier degrees in Health Informatics or in related fields is required to update and certify their current knowledge and skills. Therefore, eligibility and content requirements combining: 1) Clinical practice focus, 2) Education, and 3) Significant experience in real-world health informatics accomplishment is urgently needed to ensure qualified expertise and develop “best practices”.
- EFMI as the scientific federation in Europe of this discipline has the obligation to offer certification processes and certify the professionals of the current required skills in the field of Biomedical and Health Informatics.

Conclusions

- Quality of education is of paramount importance, ensuring adequate knowledge and skills, and monitoring that inter- professionalism is applied from the very beginning, developing a quality pathway towards capacity building of professionals in Biomedical and Health Informatics.
- The means for monitoring the quality of education is the evaluation through objective accreditation and certification procedures
- To this end, EFMI is implementing the EFMI AC2 Certification procedure to the HOSMARTAI trainees, based on their needs and requirements as described in the project guidelines.

5 Certification, Training and alignment actions and material mechanisms – report

The certification and training plan has been carried out through the HosmartAI partners' collaboration: EFMI, AUTH and supported by UKCM, IRCCS, FIBHULP, CHUL, AHEPA, VUB, and partners involved in the 8 Pilots.

5.1 Organization of initial feedback from partners

The T6.4 activity started on month 19 of the project. The leader is EFMI, selected for the competencies in certification and accreditation, based on the experience of the EFMI AC2 committee and the pool of European experts that supported the process.

Identify groups, needs, level of training & certification. In the initial phase the team studied the pilots and partners' activity in the project and investigated the need for accreditation, training, and certification - topics of interest that relate with the HosmartAI project – AI, IoT, robotics and the interested professional groups finalised with launching an exploratory questionnaire disseminated to pilots and partners.

The WP6 workshop during the Plenary meeting 6 in Madrid had a section dedicated to Accreditation, Training and Certification (ATC) activities, presenting the EFMI AC2 procedures and launching a questionnaire for assessing the needs of the partners. The results of the questionnaire are summarized in Appendix A to this document.

Analysing the needs assessment and partners' feedback, the ATC team decided the topics and timeline for the future activities. There was clearly a need for more in depth presentations of the activities, and more dedication of the team to clearly explain the activities, the content, the time, and benefits, to motivate the partners that were already involved in many activities. Appendix B contains the results of the second questionnaire presented to participants.

The next activities were the developing of learning objectives, design and develop training materials, perform A/C/T activities.

5.2 Development of training materials

The ATC team observed a diversity of professions and domains of interest resulting from the answers of the previous activity. Also, remarked a limited time availability to study and participate in activities outside their day-to-day activity that usually were very demanding.

The first conclusion was that there is no need for an Accreditation process, so we focused on training and certification activities (TC). The second conclusion was that some challenges in defining the learning objectives may arise due to this diversity and overload. Consequently, we decided to follow a step-by-step more refined process.

The competencies selected were Information and Communication Technologies, Health and Biomedical Sciences, Information Sciences, Management Sciences, BMHI Principles, Ethics, Human and Social Context, Specialization (e.g., AI). Based on these targets, the curriculum proposed to the partners consisted of:

1. Introduction to Biomedical and Health Informatics. Computing Concepts for Biomedicine and Health. Human-Computer Interaction.

2. Electronic Health Records. Standards and Interoperability. Health Information Exchange (HIE). EHR System Selection and Implementation. Health Information Privacy and Security. Information Retrieval / Search

3. Clinical Decision Support. Evidence-Based Medicine.

4. Telemedicine and Telehealth (30 slides)

5. Artificial Intelligence. Natural Language Processing.

6. Ethical Issues in Health Informatics Safety, Quality, and Value

aiming to cover important current topics at a medium level of understanding.

Subject to the Grant Agreement, there are 7 partners involved in the T6.4 activity. Partner AUTH agreed contributing to Chapter 4, EFMI contributing to the rest of 5 Chapters. The other partners involved with a small amount of work supported the team with participants in the activities that followed.

To evaluate the validity of the selection related to objectives and topics the TC team prepared 2 meetings with partner members.

The first was online, on Friday, 24.11.2023, with presentations related to topics, level of difficulty and clarifications of the process.

The second one included several presentations during the Plenary agenda in Maribor, 29-30 November 2023. John Mantas from EFMI, chair of EFMI AC2 committee prepared video presentations clearly describing the TC process and presenting one Chapter, Emmanouil Rigas from AUTH presented live the Chapter 4 content and answered specific questions. Lacramioara Stoicu-Tivadar, EFMI coordinator for the project, presented Chapter 5 and answered to specific chapter questions and to the ones more general explaining the process. The activity proved effective, people understanding and giving good feedback that they are interested in participation to TC activities. For the 2 training sessions online and f2f we had an audience of 48 participants from the 23 partners and all 8 HosmartAI pilots.

A timeline for the process was established. Appendix B presents the questionnaire presented to partners to refine the needs assessment related to training and certification materials.

For all 6 chapters the study material were developed by colleagues from EFMI and AUTH team. An example of the process is given for Chapter 4.

Creation and Delivery of an Offline Telehealth and Telemedicine Educational Material (&4.3)

This section describes the process of creating and delivering a lecture on tele-health and tele-medicine, held offline to engage healthcare professionals and practitioners directly. The lecture aimed to equip participants with essential understanding and knowledge for potentially integrating telehealth technologies into their healthcare practices effectively.

The lecture preparation involved thorough research into the latest advancements in telehealth. This included reviewing current literature, engaging with telehealth technology experts, and gathering insights from successful telehealth implementations. The aim was to ensure the content was not only informative but also aligned with the latest industry standards and practices.

To facilitate engagement in an offline setting, the educational materials were designed with a strong focus on visual and interactive elements. PowerPoint slides were used as the primary teaching tool and the slides included not only text by detailed diagrams, and charts. These materials were crafted to cater to different learning styles, ensuring clarity and retention of complex concepts.

A significant challenge was presenting technical information in a manner accessible to all attendees, who had varying degrees of familiarity with digital technology. Additionally, condensing comprehensive telehealth topics into a single session without oversimplifying required meticulous planning and content prioritization.

Delivering the lecture offline reinforced the value of direct interaction in educational settings, particularly for complex technological subjects like telehealth. It also highlighted the importance of being flexible and responsive to the needs of the audience. Feedback from the participants was positive, highlighting the effectiveness of the interactive approach and the practical relevance of the content.

Overall, the experience of developing and delivering an offline lecture on tele-health and tele-medicine was immensely rewarding. It provided significant insights into effective educational strategies for complex technological fields and highlighted the ongoing need for professional development in healthcare technologies. The knowledge and feedback gained from this lecture will be instrumental in shaping future educational efforts, ensuring they are as impactful and informative as possible.

After the EFMI AC2 review (see 5.3) and changes done, the TC team launched a questionnaire for the partners to have their feedback related to topics, clarity, and difficulty. An intense exchange of emails was performed with partners representatives to obtain best results for the training materials.

5.3 EFMI AC2 feedback

Following the workshop and presentations during Plenary 7 the TC team refined the documentation for the 6 chapters. The EFMI AC2 committee members agreed to review the materials. All 6 chapters were thoroughly reviewed by the EFMI AC2 members, who are distinguished professionals in digital, health related disciplines. All the anonymized reviews are available on the project SharePoint. The developers of the content made the changes suggested by the EFMI AC2 committee reviewers, and a new version was ready to present to the partners (Appendix D).

5.4 Development of evaluation support

For the evaluation of the results of the training process the team prepared for each chapter a set of 10 questions, each with 3 answers, only one correct. The modality of evaluation was adapted to the requirements of the project and the grade of availability of the participants.

The tests were developed by each author and contained questions with a grade of difficulty starting generally from medium and having several ones above medium, depending on the topic (Appendix E).

For each questions set corresponding to each chapter a review was performed by 7 EFMI colleagues from RSMI. The new revised set of tests were presented to participants, and they started the learning activity.

Partners were notified to enrol for the certification process. They had to fill in a questionnaire with name, contact details and partner name. This resulted in 39 applications.

5.5 Certification

The results of the evaluation tests were presented to each participant, separately, ensuring privacy and anonymity. They were of type admit/reject. The admitted participants answered more than 50% of the questions correct (Appendix F).

The obtained results are very good, as shown in Figure 4.

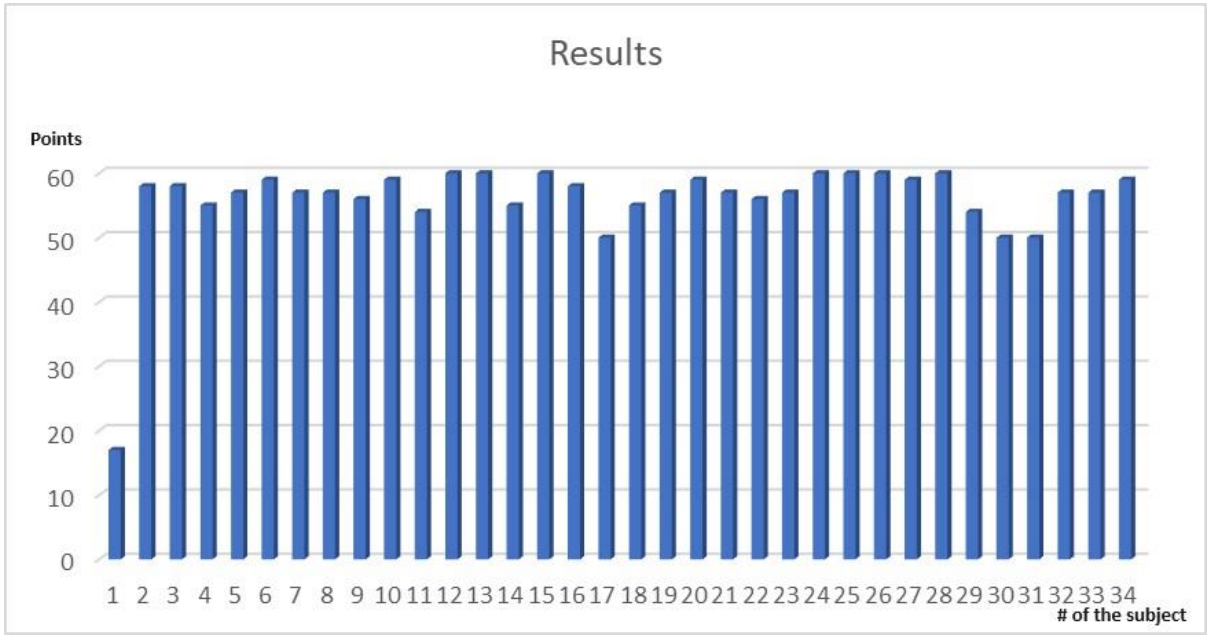


Figure 4: The overall results.

One participant failed, 33 others passed, the admission ratio resulting **97.06** %. The marks are quite good, all the admission marks are between 50 and 60 points, i.e. between **83.33 %** of maximum mark, and maximum mark **100 %.**

The marks are distributed in the range between 17, and maximum 60, according with the total number of questions (60) (see Figure 5):

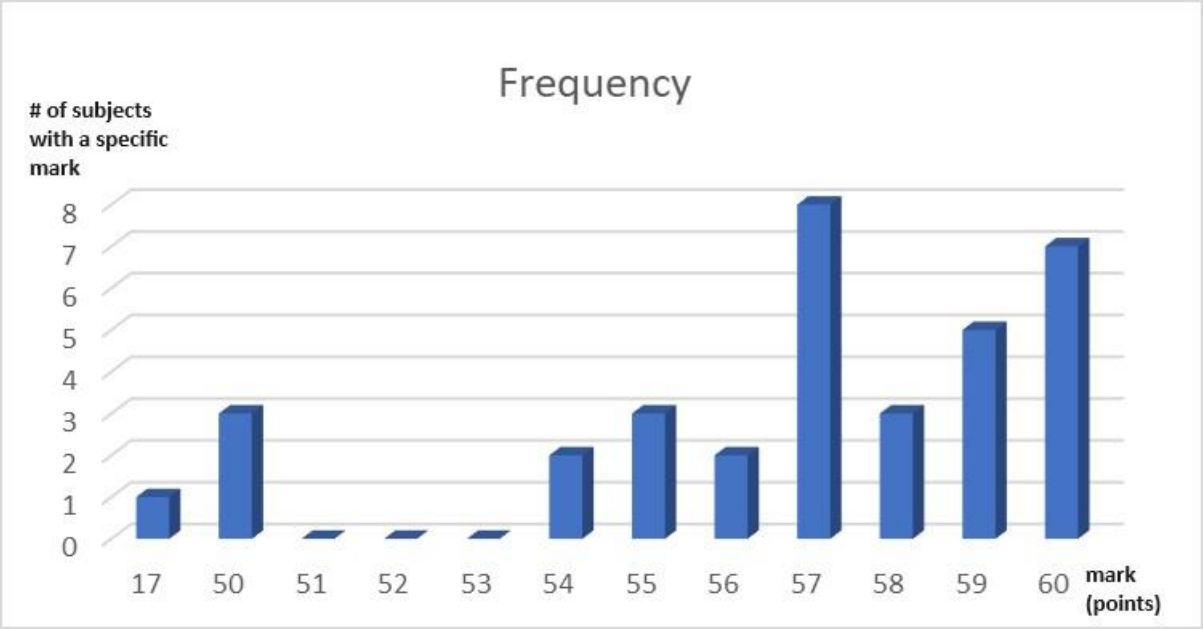


Figure 5: The distribution of the marks.

Relevant as difficulty of the content of the chapters is to analyse the distribution of total marks as seen in Figure 6:

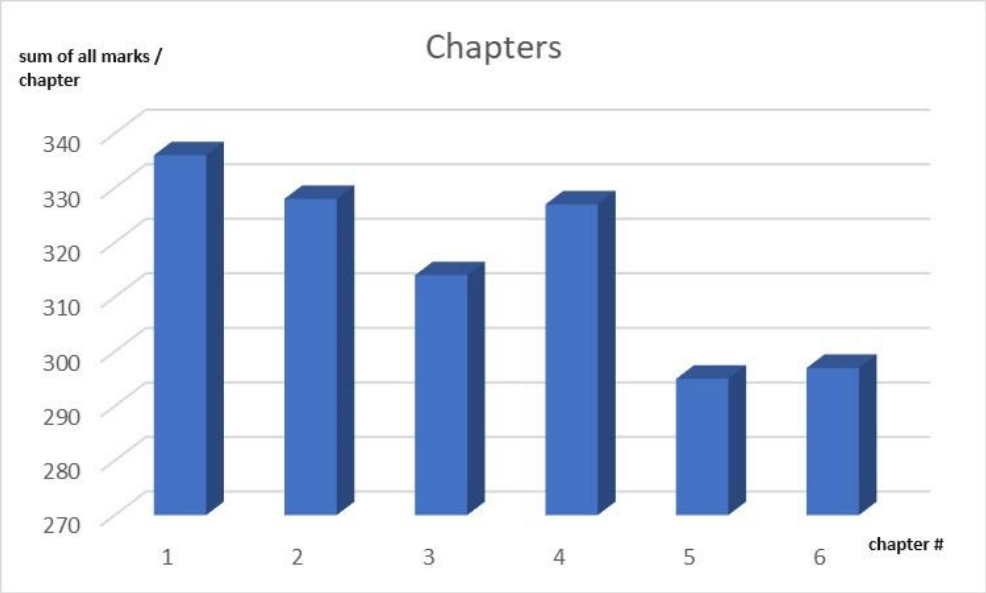


Figure 6: Total sum of the points for each chapter.

As expected, the most difficult chapters are the final 5, and 6 ones, with topics not so easy to understand, which correspond to decreased marks related to other ones. That means as an important conclusion for future assessments, and certification processes, to improve, and allocate more time for tuition of the corresponding topics. The introductory chapter was easy to understand and learn, having as a consequence a large number of maximum marks.

The EFMI team prepared the Certification diploma (Appendix G) that was handed to the successful participants present at the 8 Plenary, during a special ceremony.

6 Key Performance Indicators

For the task T6.4 in WP 6, the Key Performance Indicators were aiming for

- KPI: **Staff training/educational activities**. Target value: > **5** per technology. Verification means: D6.6.
- KPI: **Certifications to Healthcare professionals**. Target value: > **10**. Verification means: D6.6.

The KPIs after the Training and Certification activities during M29-M40 were achieved and at certification they were generously exceeded.

Staff training/educational activities: 43 participants

Certifications to Healthcare professionals: 32 participants

7 Conclusions

Value of the deliverable: training focused on the needs and knowledge level of the participants, the learning objectives were aligned with the current topics and the needs of the project, the certification process proved that participants are dedicated to their careers and are willing to invest time and effort into learning new things. The certification program provided a sense of accomplishment, completion, and pride and improved job prospects and earnings potential.

Partners that were more engaged: from the 23 partners we had applications from 11. We had enrolment from 39 persons, finally we had 34 enrolled and the main engagement came from ITCL TECHNOLOGY CENTRE with 15 participants that finalised successfully the certification process.

Achievements within this task: the performed activities for task T6.4 resulted in 6 chapters presenting topics reflecting the needs of participants and alignment with current practice, and 34 certified professionals.

Feedback from partners: after evaluation, participants were invited to answer to a feedback questionnaire. 20 answers from 8 partners were collected. 90% stated that the material from the 6 chapters reached totally (65%) or almost (25%) its goal and is it useful for the formation of the profession. When asked how much did the discipline demand of you by its degree of difficulty and by the amount of material, 3 persons appreciated it as difficult, 9 as somehow difficult, 6 not very difficult and 2 easy. 80% of the participants appreciated that overall, the certification process is relevant to their work in the frame of the HosmartAI project.

8 Relative literature

1. Kern DE. Curriculum development for medical education: a six-step approach. JHU Press, 1998.

2. Hsu CC, Sandford BA. The Delphi technique: making sense of consensus. Practical Assessment, Research & Evaluation 2007;12:1-8.

3. Forehand, M. Bloom's taxonomy. In: Orey M. editor. Emerging Perspectives on Learning, Teaching, and Technology (E-Book). 2010:41-7. Available online: https://textbookequity.org/Textbooks/Orey_Emergin_Perspectives_Learning.pdf

4. Topol E. The topol review. Preparing the healthcare workforce to deliver the digital future. 2019 Feb:1-48. https://topol.hee.nhs.uk

5. Bichel-Findlay J, Koch S, Mantas J, et al. Recommendations of the International Medical Informatics Association (IMIA) on education in biomedical and health informatics: second revision. International Journal of Medical Informatics, 2023 Feb 1;170:104908

Appendix A Needs assessment – early phase

How many trainings have you provided to healthcare professionals?
0
0
0
0
0
2
2
2
2 - 1 per sprint involving demos and testing
3
at least 6
For hosmartai? 20-30
In general? Many
Heart
Heart
Heart
no, but will do in the future
None
Thumbs up
Thumbs up
Training activities: How many hours per month can you dedicate to receiving training between September 2023 and March 2024?
Thumbs up
n.a.
n.a.
n.a.
n.a.
n.a.
n.a.
n.a.
Heart
8 hr/month
8 hr/month
8 hr/month
8 hr/month
4 hr/month
4 hr/month
4 hr/month
4 hr/month
> 8 hr/month
> 8 hr/month

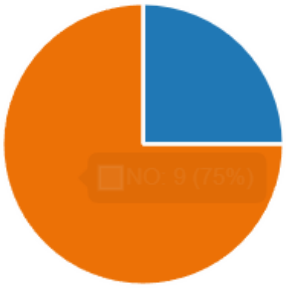
Appendix B Questionnaire related to accreditation and training

HosmartAI Questionnaire related to accreditation and training

1. Do you have a training program? (0 punct)

Mai multe detalii

YES	3
NO	9



2. Do you wish to be accredited by EFMI? (0 punct)

Mai multe detalii

YES	2
NO	1

3. Please provide title, aim, scope, target group, details of program, duration, etc

Training programs which want to be accredited by EFMI

Gradior Program for healthcare professionals; training with the cognitive stimulation digital tool, basic course 1 day and advance course several weeks (Pilot 6 – INTRAS - Rosa / Raquel / Tere / Diana - rra@intras.es)

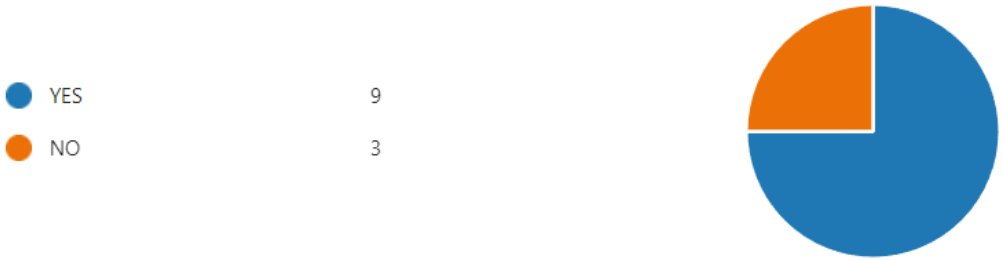
Pilot 4: robotic ablation of cardiac arrhythmias (Pilot 4 – SERMAS - Jose L. Merino - jlmerino@arritmias.net)

4. Reasons, for example: is the program already accredited and by which organization

-

5. Do you wish to have a training program prepared by EFMI and leading to certification of your personnel?

Mai multe detalii



6. What are the reasons?

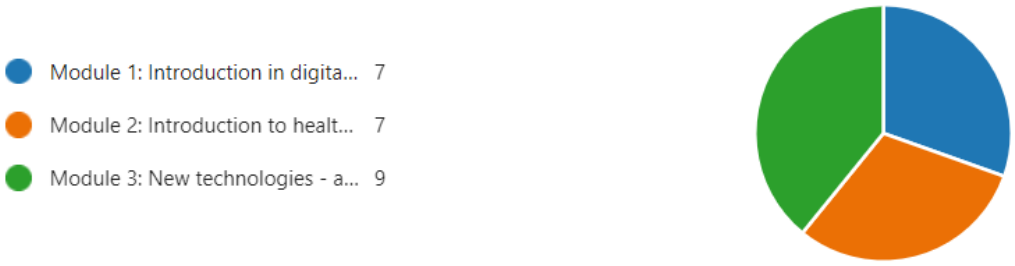
we have internal with our technical, local partner (Pilot 5- UKCM - Maja Molan maja.molan@ukc-mb.si)

Not needed. thanks. (Pilot 2 - ITCL TECHNOLOGY CENTRE - Marteyn van Gasteren marteyn.vangasteren@itcl.es)

Our company is not producing medical devices (Pilot 3 – VIMAR - Alberto Pomella - Alberto.pomella@vimar.com)

7. As a HosmartAI pilot or partner your institution/company members are invited to benefit from the following Training opportunities, which will be Certified by EFMI:

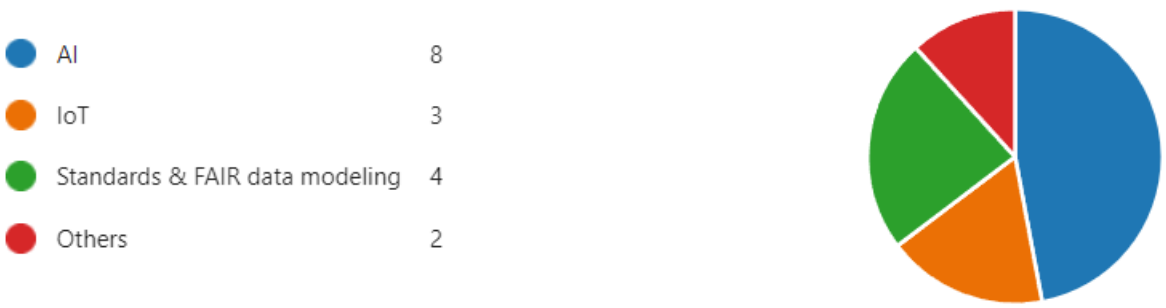
Mai multe detalii



Module 3: New technologies - alignment with existing practice (duration TBD);		9	VUB	Nivedita yadav	nivedita.yadav@vub.be
Module 1: Introduction in digital health (duration TBD);Module 2: Introduction to health information systems (duration TBD);Module 3: New technologies - alignment with existing practice (duration TBD);		4	91	Arber	arber@91.life
Module 3: New technologies - alignment with existing practice (duration TBD);Module 2: Introduction to health information systems (duration TBD);Module 1: Introduction in digital health (duration TBD);		1	AUTH	Georgios Apostolidis	g.k.apostolidis@gmail.com
Module 1: Introduction in digital health (duration TBD);Module 2: Introduction to health information systems (duration TBD);Module 3: New technologies - alignment with existing practice (duration TBD);			SMARTSOL	Oksana	oksana@smartsol.lv
Module 1: Introduction in digital health (duration TBD);Module 2: Introduction to health information systems (duration TBD);Module 3: New technologies - alignment with existing practice (duration TBD);	Robotics, Graphic use interfaces	4	SERMAS	Leonardo Elias Guido l	leoguidolopez@gmail.com
Module 1: Introduction in digital health (duration TBD);Module 2: Introduction to health information systems (duration TBD);Module 3: New technologies - alignment with existing practice (duration TBD);	Robotics	4	SERMAS	Miguel Jáuregui	miguel.jauregui.abu@gmail.com
Module 1: Introduction in digital health (duration TBD);Module 2: Introduction to health information systems (duration TBD);Module 3: New technologies - alignment with existing practice (duration TBD);		6	INTRAS	Rosa / Raquel / Tere / I	rra@intras.es
Module 1: Introduction in digital health (duration TBD);Module 2: Introduction to health information systems (duration TBD);Module 3: New technologies - alignment with existing practice (duration TBD);		2	CHUL	Marcela Chavez	vchavez@chuliege.be
Module 3: New technologies - alignment with existing practice (duration TBD);		4	SERMAS	Jose L. Merino	jlmerino@arritmias.net

8. If you answer Module 3, please check what topics are you interested in: (0 punct)

Mai multe detalii



9. If choose OTHERS, add what topics are you interested in:

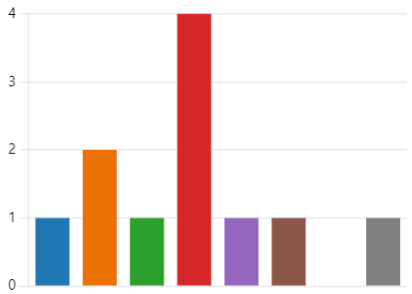
Robotics, Graphic use interfaces

Robotics

10. Pilots (0 punct)

Mai multe detalii Detalii

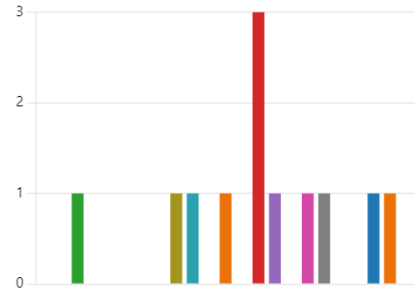
1	1
2	2
3	1
4	4
5	1
6	1
7	0
9	1



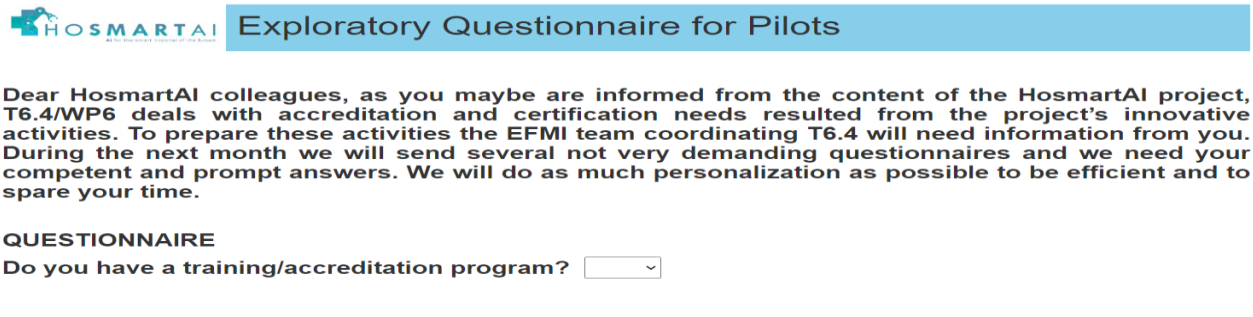
11. Partners (0 punct)

Mai multe detalii Detalii

NETCOMPANY - INTRASOFT	0
PHILIPS	0
VIMAR	1
GC	0
TMA	0
EXYS	0
PhE	0
F6S	0
SMARTSOL	1
91	1
EIT	0
UKCM	1
SCI	0
SERMAS	3
CHUL	1
AHEPA	0
VUB	1
AUTH	1
ETHZ	0
UM	0
ITCL TECHNOLOGY CENTRE	1
INTRAS	1
HOPE	0



Appendix C Exploratory questionnaire for pilots



HOSMARTAI Exploratory Questionnaire for Pilots

Dear HosmartAI colleagues, as you maybe are informed from the content of the HosmartAI project, T6.4/WP6 deals with accreditation and certification needs resulted from the project's innovative activities. To prepare these activities the EFMI team coordinating T6.4 will need information from you. During the next month we will send several not very demanding questionnaires and we need your competent and prompt answers. We will do as much personalization as possible to be efficient and to spare your time.

QUESTIONNAIRE

Do you have a training/accreditation program?

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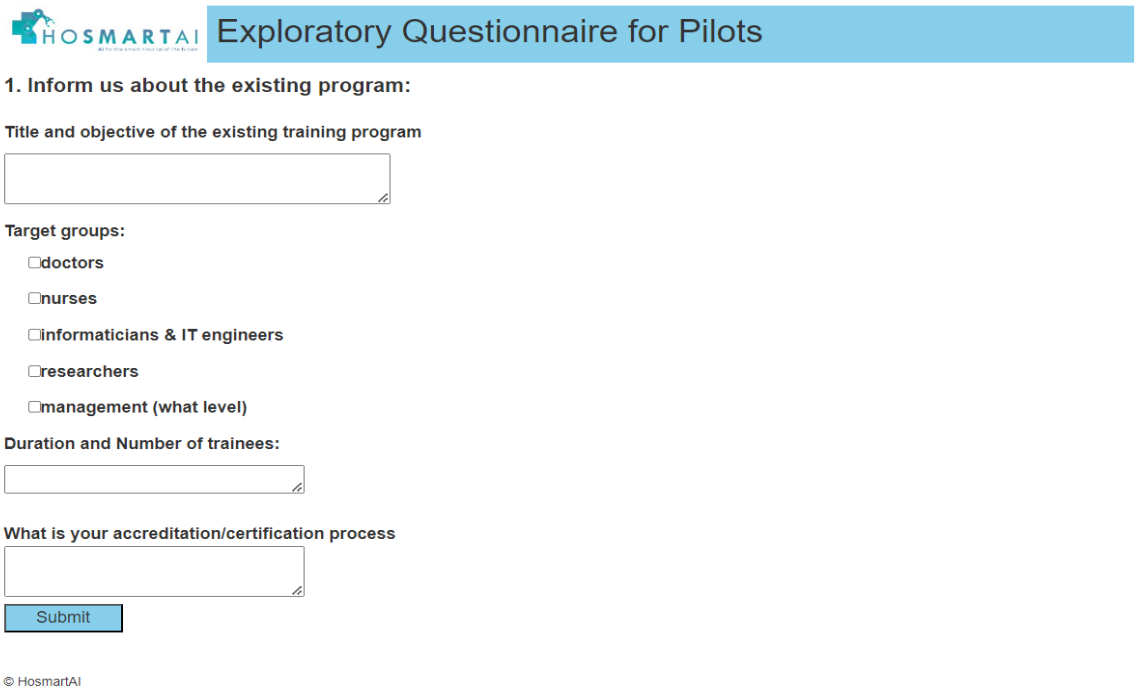

HOSMARTAI Exploratory Questionnaire for Pilots

1. Inform us about the existing program:

Title and objective of the existing training program

Target groups:

- ☐ doctors
- ☐ nurses
- ☐ informaticians & IT engineers
- ☐ researchers
- ☐ management (what level)

Duration and Number of trainees:

What is your accreditation/certification process

Submit

© HosmartAI

Exploratory Questionnaire for Pilots

Is there a need for training? YES

What domain:

- ☐ AI
- ☐ Robotics
- ☐ IoT
- ☐ Standards
- ☐ FAIR
- ☐ Other:

What domain:

- ☐ doctors
- ☐ nurses
- ☐ informaticians & IT engineers
- ☐ researchers
- ☐ management (what level)

Number of trainees:

Submit

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Exploratory Questionnaire for Pilots

Is there a need for training? NO

motivation of not needing training/accreditation?

Submit

© HosmartAI

	id	title	target1	target2	target3	target4	target5	level	Duration_nr	accreditation
1	10	Bbb	1	0	1	0	0		4	Rrr
2	11	Employee integ…	1	1	1	1	1	mid-level	The duration o…	The objectif i…
3	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

date
2/27/2023 1:30…
2/28/2023 11:12
NULL

	id	AI	Robotics	IoT	Standards	FAIR	Other	Doctors	Nurses	Inf
1	10	0	0	1	1	1		0	0	1
2	11	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
3	12	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
4	13	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
5	14	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
6	15	1	1	1	1	1		0	0	0
7	16	1	0	1	0	0		0	0	1
8	17	1	0	0	1	0		1	1	0
9	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

Researchers	Management	Level	Trainees	Motivation	date
0	0		2	NULL	2/27/2023 1:30…
NULL	NULL	NULL	NULL	-	2/27/2023 4:54…
NULL	NULL	NULL	NULL	--	2/27/2023 4:55…
NULL	NULL	NULL	NULL	Pilot 5 is a f…	2/28/2023 6:22…
NULL	NULL	NULL	NULL		2/28/2023 2:10…
0	0			NULL	2/28/2023 3:23…
0	1	top-level		NULL	3/10/2023 10:0…
0	0			NULL	3/10/2023 10:1…
NULL	NULL	NULL	NULL	NULL	NULL

If YES			
the existing training program	Employee integration path		
Target goups			
doctors	x		
nurses	x		
informaticians and IT e	x		
researchers	x		
management (what leve	mid-level		
Duration and Number o	training depends on the target group, but it usually covers several sessions.		
What is your accreditation/certification process	obtain the Joint Commission International certification (JCI)		
Is there a need for training?			
if YES			
What domain:			
AI	x	x	x
Robotics	x		
IoT	x	x	
Standards	x		x
FAIR	x		
Others			
What domain:			
doctors			x
nurses			x
informaticians&IT engineers		x	
researchers			
management (what level)		top-level	
Number of trainees:			
If NO			
Motivation of not needing training/accreditation	Pilot 5 is a feasibility study at TRL6 at most. The experiments are carried out with and under supervision of researchers (specially tech. staff) involved in the design and implementation of functionalities.		

Appendix D Chapters 1-6 print screens

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AI for the smart hospital of the future

Biomedical and health informatics: an Introduction

EFMI EUROPEAN FEDERATION for MEDICAL INFORMATICS

Presented by
Professor John Mantas
Professor Lăcrămioara Stoicu-Tivadar

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

Contents

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Human Computer Interaction

Image by alvaro_cabrera on Freepik

Types of interaction (cont.)

Gesture interaction – using camera/devices

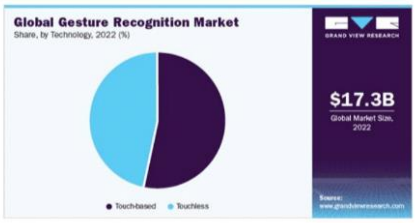

Figure 1. Game for RA stage I

Figure 4. Results

Figure 2. Game for RA stage II

Figure 5. Ulnar flexion

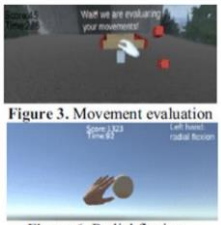

Figure 3. Movement evaluation

Figure 6. Radial flexion

- Recovery
- Sign Language
- Lab & Operating Rooms
- Diagnosis
- Education

34

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Electronic Health Records and Security

EFMI EUROPEAN FEDERATION for MEDICAL INFORMATICS

Presented by
Professor John Mantas

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

Objectives

EFMI EUROPEAN FEDERATION for MEDICAL INFORMATICS

1. Presenting general information related to Electronic Health Record (EHR) – background, current outlook and some examples.
2. Describing how patients interact with the EHR via their personal health record (PHR).
3. Understanding information retrieval and how it is used.

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Understanding data, information, knowledge and wisdom

- **Data** are raw materials that are gathered and kept.
- **Data** are given structure and meaning by **information.**
- Understanding and application to novel situations are made possible by **knowledge.**
- Some expand this continuum to include a fourth term, **wisdom** which is defined as applying knowledge.

6

Clinical data

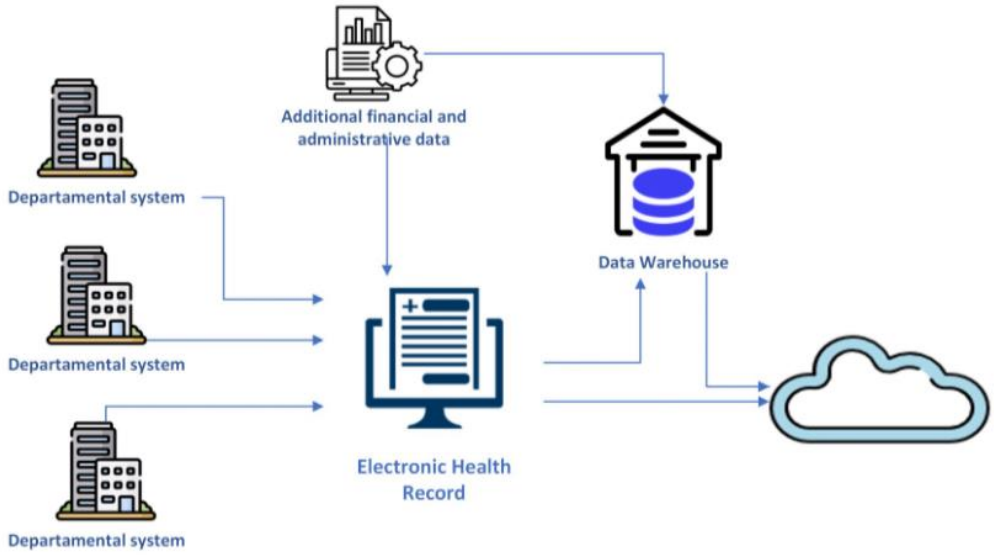
In their notes, most clinicians adhere to a rather generic pattern, particularly when evaluating a stable patient.

These consist of:

- principal grievance;
- the current illness's past;
- previous health records;
- historical social;
- ancestral history;
- system evaluation;
- a physical assessment;
- lab, x-ray, and other testing;
- evaluation and strategy.

13

EHR data ecosystem



27

Challenges for Knowledge – Based Information

- There are several challenges for knowledge-based information in biomedicine and health:
  - Misinformation;
  - Misconduct;
  - Retractions;
  - Publication bias.

35

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EUROPEAN FEDERATION for MEDICAL INFORMATICS

Clinical Decision Support

Presented by
Professor John Mantas

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

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HOSMARTAI 2

CDS Technologies – Knowledge-Based Interventions

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HOSMARTAI

- In **synchronous** CDS, the intervention is provided in real time as the user is interacting with the clinical information system or is making or executing decisions. Examples of this include specialized data displays that aid decision-making while a user is interacting with an EHR system and pop-up or otherwise interruptive alerts that must be addressed before a user may proceed with other uses of a system.
- In **asynchronous** CDS, the link between intervention and user does not occur in real time. Examples of the latter may include messages communicated by fax, email or similar channels which the user may retrieve at her convenience or leisure.

23

Role of standards in CDS

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HOSMARTAI

- **Standards** can facilitate the dissemination and uptake of CDS by:
  - making it easier to share knowledge, implement communication between knowledge sources and EHR systems,
  - access clinical data from within a CDS system and produce actionable knowledge-based interventions.
- The **use of standards**:
  - eases the challenges facing health care organizations when implementing health information technology,
  - allowing integration of software from different vendors and making the organizations less dependent on single points of failure in case a vendor goes out of business or halts a particular line of software or service production.

24

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Artificial Intelligence
Natural Language Processing

Presented by
Professor Lăcrămioara Stoicu-Tivadar

EFMI EUROPEAN FEDERATION for MEDICAL INFORMATICS

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

AI in Healthcare – what is and how it works

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- AI in healthcare combines application of machine learning (ML) algorithms with cognitive technologies in medical settings usually with the goal of **predicting** a particular outcome.
- a significant AI use case in healthcare is the use of ML and other cognitive disciplines for medical diagnosis purposes. Using patient data and other information, AI can help doctors and medical providers deliver **more accurate diagnoses and treatment plans**. AI helps making healthcare more predictive and proactive by analyzing big data to develop improved preventive care recommendations for patients.
- computers mimic human cognition and are capable of learning, thinking, and making decisions or taking actions.

Artificial Intelligence model – an outline

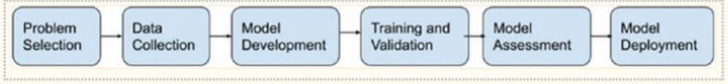


Figure 1

Illustration outlining the development of an artificially intelligent model

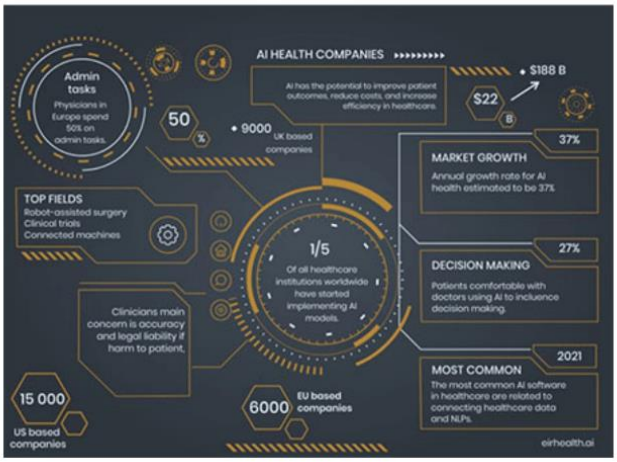
https://www.arm.com/glossary/ai-in-healthcare, Artificial Intelligence: How is It Changing Medical Sciences and Its Future?, Kanadpriya Basuet al., Indian J Dermatol. 2020 Sep-Oct; 65(5): 365–370.

6

AI in healthcare – view & challenges

- AI in healthcare is expected to grow 37% annually.
- 1 out of 5 healthcare institutions globally have started working on implementing some sort of AI.
- only 27% of patients are comfortable with AI in clinical decisions - shows there is still work to do to improve the acceptance of AI in healthcare.

A suspicious look



12

Virtual Nursing Assistants

- From interacting with patients to directing patients to the most effective care setting, virtual nursing assistants could save the healthcare industry **$20 billion** annually.
- **What**
  - Monitor patients
  - Answer questions
  - Provide quick answers
- **When**
  - Available 24/7
  - More regular communication between patients and care providers between office visits to prevent hospital readmission or unnecessary hospital visits
- **Examples**

  CareAngel https://www.careangel.com/ (voice, text, chat) - link to EmpowerHealth.ai (automate interaction, assessments, surveys, medication, chronic condition management etc.) **more than a chatbot ...**

  Molly https://www.youtube.com/watch?v=AU1nGpOmZpQ

  EVA https://www.youtube.com/watch?v=lyl2DzZqXMI

https://www.careangel.com/?wvideo=b6kq5cja8e

14

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Ethical Issues in Health Informatics
Safety, Quality, and FAIR principles

EFMI EUROPEAN FEDERATION for MEDICAL INFORMATICS

Presented by
Professor John Mantas and
Carlos Parra-Calderon

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

Objectives

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1. The importance of IMIA Code of Ethics for Health Information Professionals provisions
2. The ways in which ethics, law, culture, and society are intertwined.
3. The various ethical perspectives held in various nations.
4. A list of the most important ethical guidelines for health informatics
5. Health informatics ethics are applied to relevant health informatics research
6. The primary and main areas of concern with artificial intelligence and ethics.

5

Artificial Intelligence and Ethics

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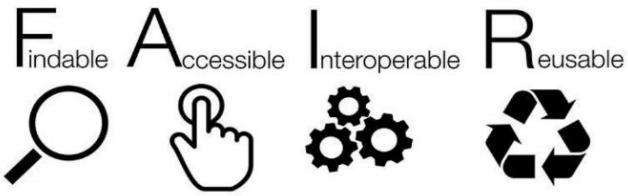
HOSMARTAI

- Machine learning, or more precisely unsupervised machine learning, requires enormous amounts of data, and sometimes the significance of certain data is unknown until the AI system has utilized the data to build a model. Simply said, the ML system scans the patient's chest x-ray rather than focusing just on the "obvious" symptoms.
- One of ML's greatest strengths is that, when examined in vast volumes, what is typically seen as noise really becomes meaningful. Thus, all of the "noise" is likewise investigated. Similarly, we don't just look at the obvious (diet, smoking, etc.) when trying to determine significant components of a patient's medical history because there can be other, far more subtle concerns that have an impact on the patient's health.
- Consequently, we want to enter all patient data from all patients so that the computer can learn as much as possible.

24

FAIR principles

HOSMARTAI



A set of principles that promote the discovery, interoperability, and reusability of data by people and machines.

29

Appendix E Questionnaire results

E.1 Chapter 1

HosmartAI partner name

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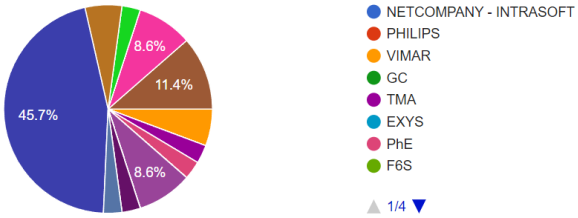
35 responses



1. What means EHR in medical informatics?

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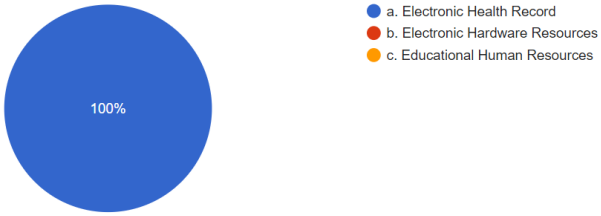
35 responses



2. What provides information?

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35 responses

3. What is sentence is true:

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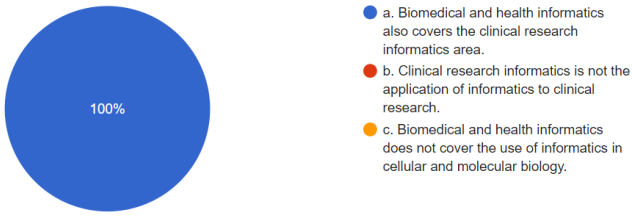
35 responses



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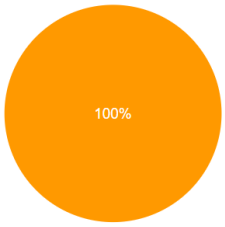
4. What is telemedicine?

35 responses



- a. is a software tool for graphic design.
- b. is a technology for wireless communication between electronic devices.
- c. is the use of telecommunications technologies to support the delivery of all kinds of medical, diagnostic and treatment-related services from distance.

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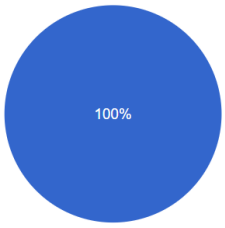
5. What is precision medicine?

35 responses



- a. is medical care that is adapted to a person's unique traits, including their genome.
- b. a technique to create medication.
- c. is the application of informatics to clinical research.

Copy

5. What is precision medicine?

35 responses

- a. is medical care that is adapted to a person's unique traits, including their genome.
- b. a technique to create medication.
- c. is the application of informatics to clinical research.

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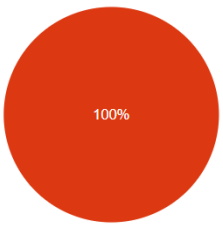
6. What is machine learning?

35 responses

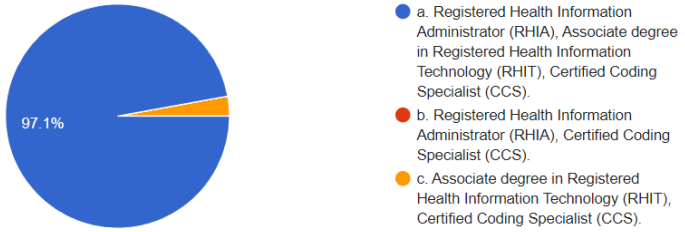


- a. is not a subfield of artificial intelligence.
- b. the use of computers to optimize a performance criterion using sample data or prior knowledge.
- c. is statistics analysis.

7. What are the primary levels of practice in Health information Management?

Copy

35 responses



8. What is Health Information Exchange?

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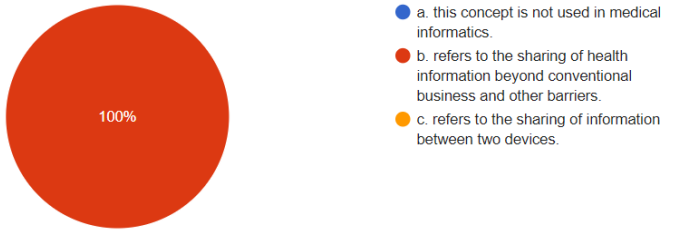
35 responses



9. Human Computer Interaction in healthcare has as main consequence

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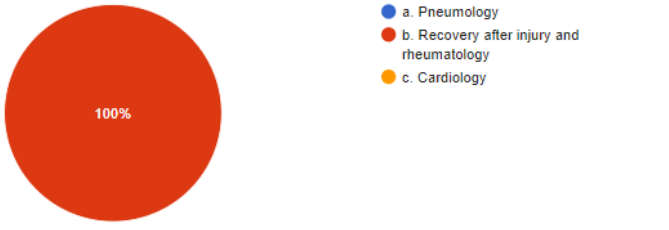
35 responses

10. One of the healthcare areas that benefits mostly of gesture recognition and interaction is

Copy

35 responses



E.2 Chapter 2

HosmartAI partner name

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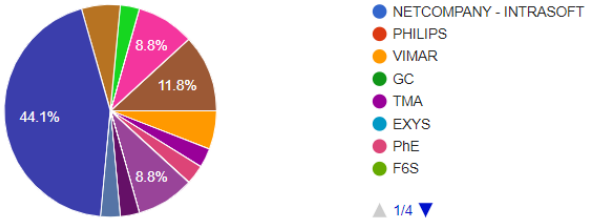
34 responses



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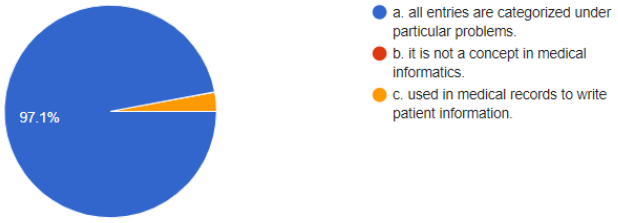
1. What is the purpose of Problem-Oriented Medical Record Approach?

34 responses



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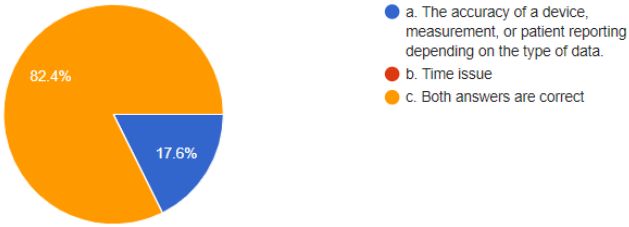
2. Which can be considered as data uncertainties:

34 responses



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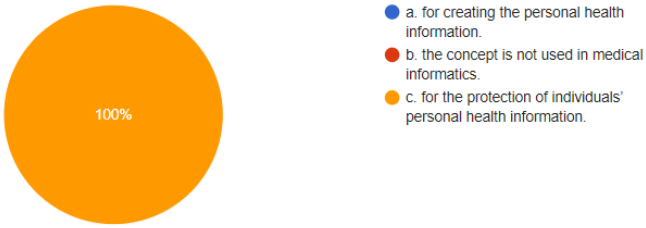
3. Why is necessary data stewardship?

34 responses



4. Which statement is true?

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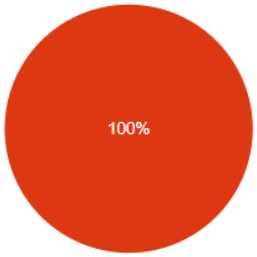
34 responses

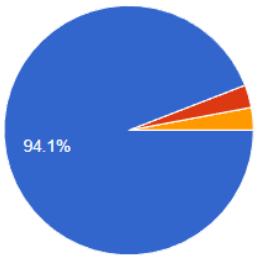


- a. It is not evaluation and enhancement of healthcare quality.
- b. EHR improves the communication with patients and other healthcare providers.
- c. EHR cannot be accessed by multiple users at once.

5. What is data in medical informatics?

Copy

34 responses

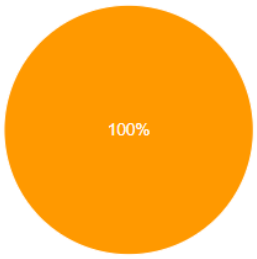


- a. are the raw materials that are gathered and kept.
- b. are information used in software applications in healthcare settings.
- c. are the finalized interpretations and diagnoses made by healthcare professionals.

6. What is the purpose of using clinical data?

Copy

34 responses

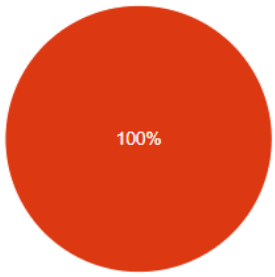


- a. to bill patients for healthcare services.
- b. to market healthcare services to patients and the public.
- c. to create the patient's care record and facilitate the provider communication.

7. What is privacy and security in medical informatics?

Copy

34 responses

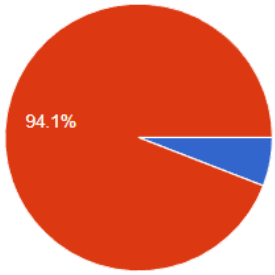


- a. are primarily concerned with the physical security of healthcare facilities.
- b. is the protection of personal data from those who should not have access to it and the ability to individuals to determine who can access their personals information.
- c. means the unrestricted sharing of patient data across all digital platforms to ensure maximum transparency.

Copy

8. Which is the future perspective related to patient ownership and control?

34 responses

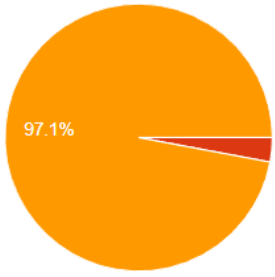


- a. Data to be kept in the isolated EHR and other systems of the healthcare facilities.
- b. Patients should have the authority to decide which healthcare providers, organizations, and researchers may access it.
- c. Patient typically can view their data, but not control it.

Copy

9. Which is the future vision of EHR?

34 responses

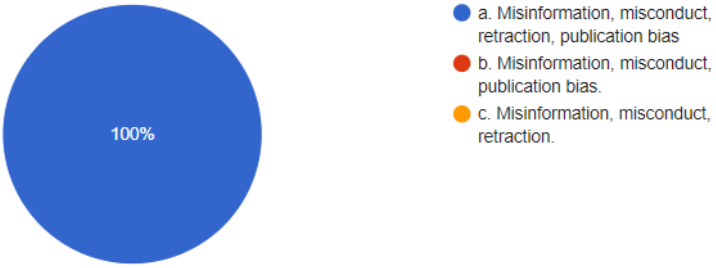


- a. To have EHR isolated to the medical unit.
- b. To have large, centralized system.
- c. To have cloud-based store instead of large, centralized system.

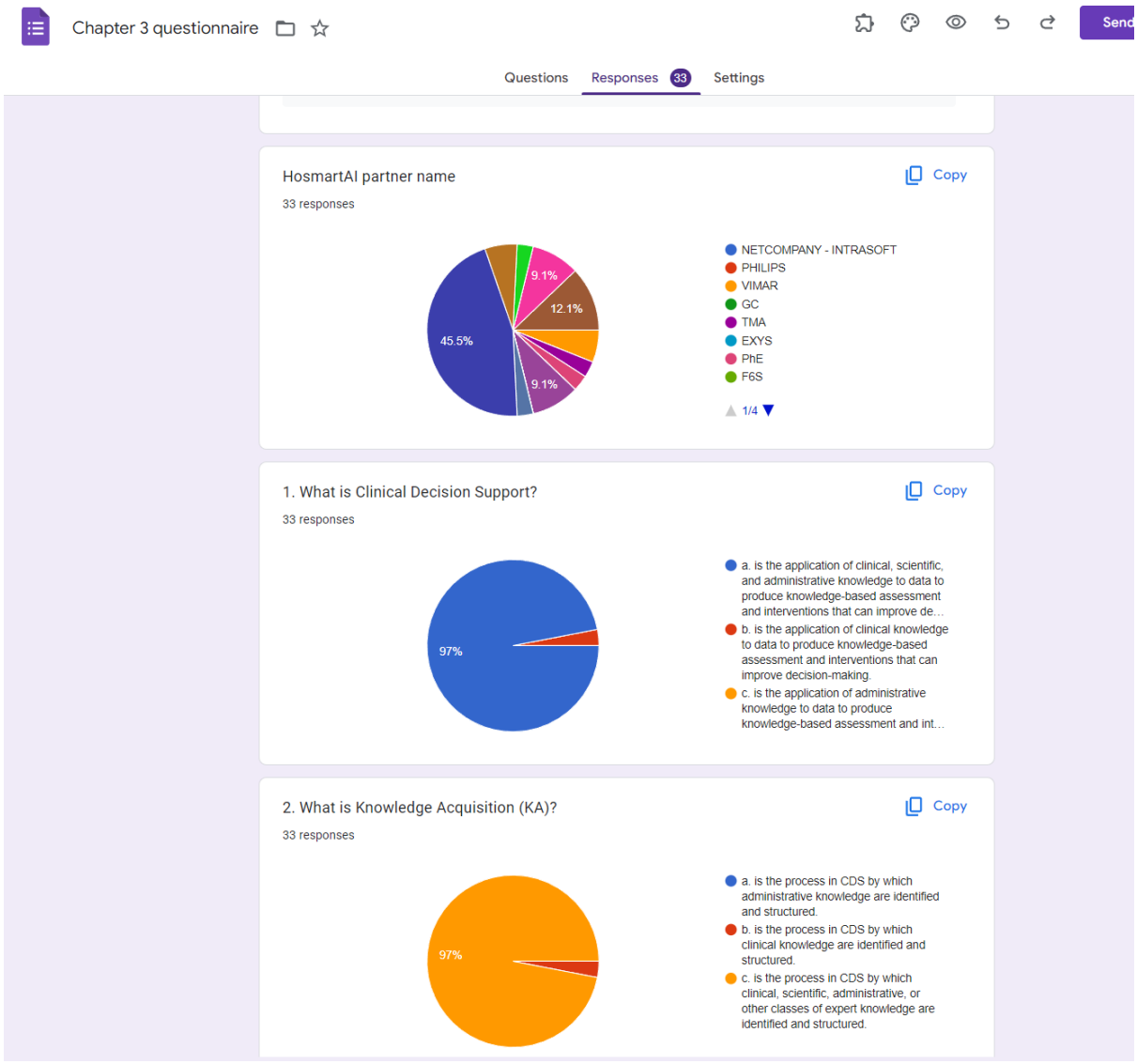
10. Which are the challenges for knowledge-based information in biomedicine and health?

Copy

34 responses



E.3 Chapter 3


Chapter 3 questionnaire
Send
Questions
Responses 33
Settings
HosmartAI partner name
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33 responses
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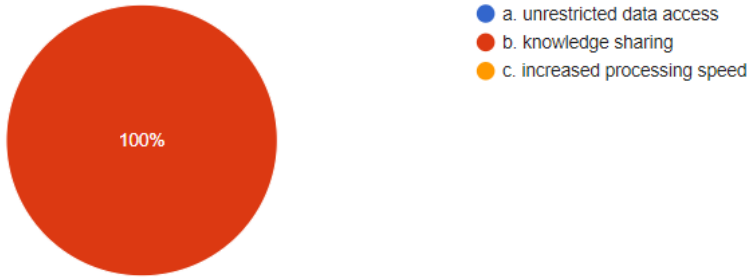
12.1%
45.5%
9.1%
NETCOMPANY - INTRASOFT
PHILIPS
VIMAR
GC
TMA
EXYS
PhE
F6S
1/4
1. What is Clinical Decision Support?
Copy
33 responses
97%
a. is the application of clinical, scientific, and administrative knowledge to data to produce knowledge-based assessment and interventions that can improve de…
b. is the application of clinical knowledge to data to produce knowledge-based assessment and interventions that can improve decision-making.
c. is the application of administrative knowledge to data to produce knowledge-based assessment and int…
2. What is Knowledge Acquisition (KA)?
Copy
33 responses
97%
a. is the process in CDS by which administrative knowledge are identified and structured.
b. is the process in CDS by which clinical knowledge are identified and structured.
c. is the process in CDS by which clinical, scientific, administrative, or other classes of expert knowledge are identified and structured.

3. What facilitates Knowledge Representation?

Copy

33 responses



4. What is inferencing?

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33 responses

5. How the system works in backward chaining?

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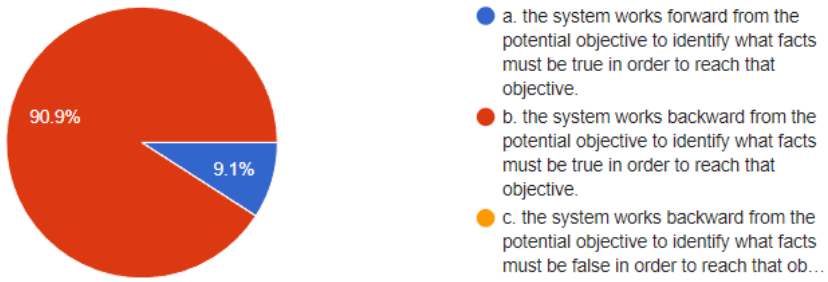
33 responses



6. How is inferencing CDS in a procedural formalism?

Copy

33 responses

- a. Inferencing can be just a matter of the computer executing commands in the knowledge base serially according to the programming language's predefined control flow.
- b. Inferencing must identify the conflict set of individual IF-THEN rules that are true at any given moment.
- c. Inferencing should identify the network bandwidth.

7. How standards can facilitate the dissemination and uptake of CDS?

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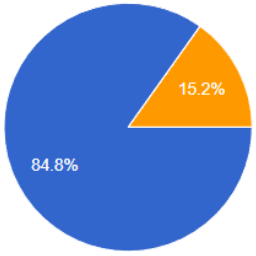
33 responses



- a. the both answers are true.
- b. access clinical data from within a CDS system and produce actionable knowledge-based interventions.
- c. by making it easier to share knowledge, implement communication between knowledge sources and EHR systems

8. What infrastructure is needed for CDS system?

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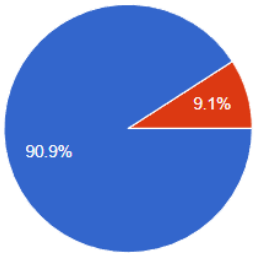
33 responses



- a. infrastructure to retrieve and interpret information and data.
- b. Infrastructure to retrieve data.
- c. Infrastructure to interpret information.

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9. How is characterized the decision support?

33 responses

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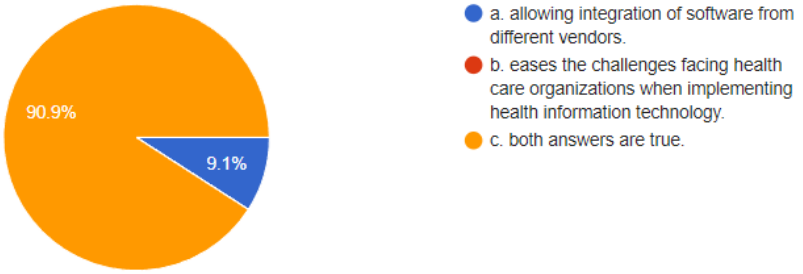
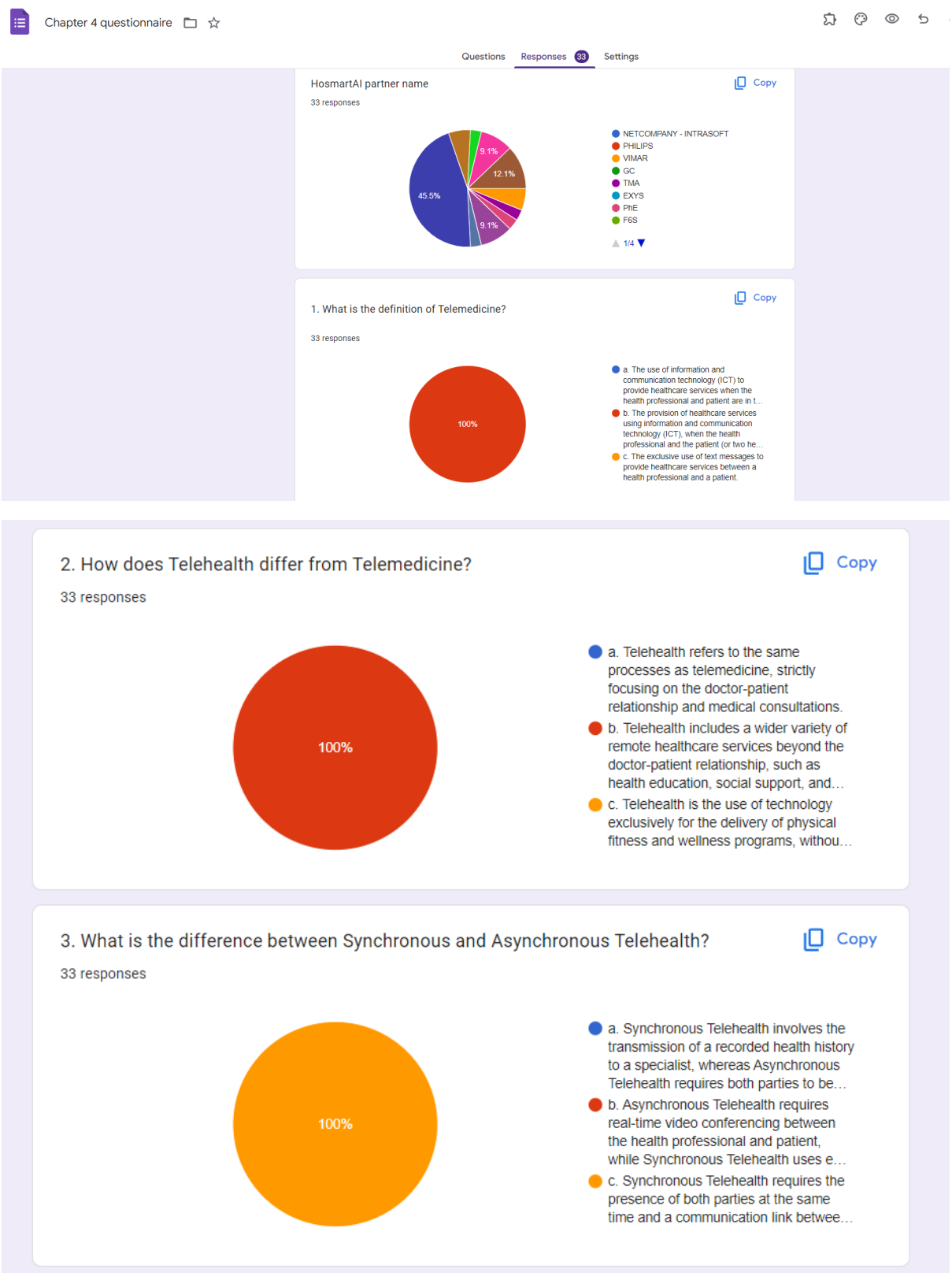
10. What are the benefits of using standards in CDS?

33 responses



E.4 Chapter 4


Chapter 4 questionnaire
Questions
Responses 33
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1. What is the definition of Telemedicine?
33 responses
100%
a. The use of information and communication technology (ICT) to provide healthcare services when the health professional and patient are in t...
b. The provision of healthcare services using information and communication technology (ICT), when the health professional and the patient (or two he...
c. The exclusive use of text messages to provide healthcare services between a health professional and a patient.
2. How does Telehealth differ from Telemedicine?
Copy
33 responses
100%
a. Telehealth refers to the same processes as telemedicine, strictly focusing on the doctor-patient relationship and medical consultations.
b. Telehealth includes a wider variety of remote healthcare services beyond the doctor-patient relationship, such as health education, social support, and...
c. Telehealth is the use of technology exclusively for the delivery of physical fitness and wellness programs, withou...
3. What is the difference between Synchronous and Asynchronous Telehealth?
Copy
33 responses
100%
a. Synchronous Telehealth involves the transmission of a recorded health history to a specialist, whereas Asynchronous Telehealth requires both parties to be...
b. Asynchronous Telehealth requires real-time video conferencing between the health professional and patient, while Synchronous Telehealth uses e...
c. Synchronous Telehealth requires the presence of both parties at the same time and a communication link betwee...

4. Which of the following cannot be considered an advancement of telehealth?

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33 responses

5. What does the acronym IoT means?

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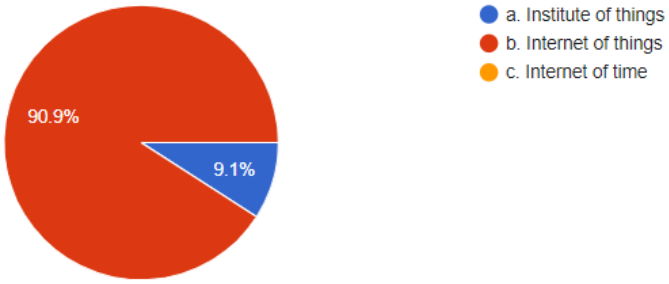
33 responses



6. Which of the following cannot be considered as a benefit of telehealth?

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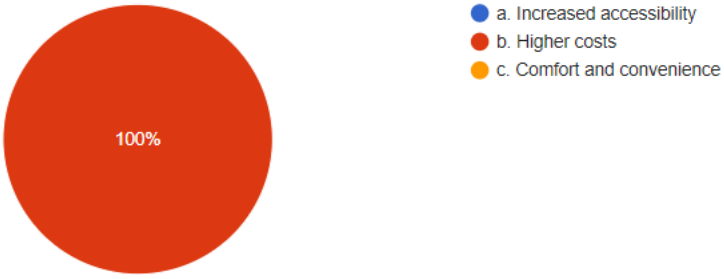
33 responses



7. Which of the following can be considered as technological and infrastructure barrier of telehealth?

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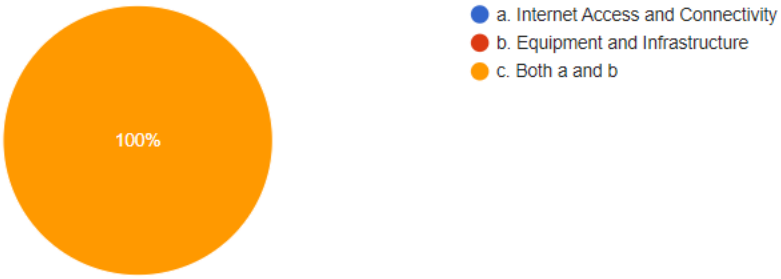
33 responses



8. What are key cybersecurity measures in Telehealth?

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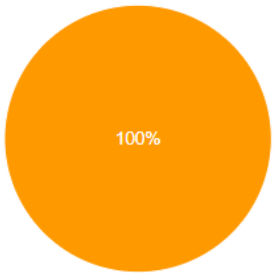
33 responses



- a. Mandatory in-person meetings and paper-based record keeping ensuring data safety.
- b. Use of public Wi-Fi networks for transmitting sensitive health information to reduce costs.
- c. Implementation of strong access controls, data encryption, anonymization and pseudonymization, and backup and disaster recovery plans.

9. What are some of the Systemic and Regulatory challenges associated with Telehealth?

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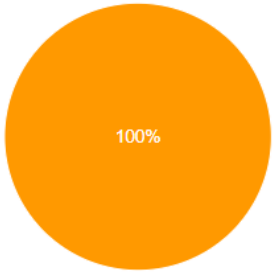
33 responses



- a. Licensing and jurisdiction issues do not limit healthcare providers as they can practice in any state regardless of where they are licensed.
- b. Reimbursement policies are consistent across all forms of healthcare, ensuring telehealth and in-person visits are equally covered by in…
- c. Challenges include licensing and jurisdiction issues, inconsistent reimbursement policies, building a str…

10. What are the benefits of empowering patients and care providers through technology in Telehealth?

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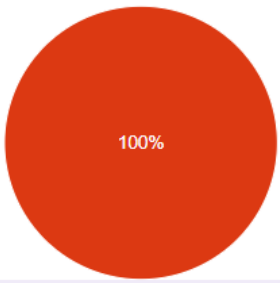
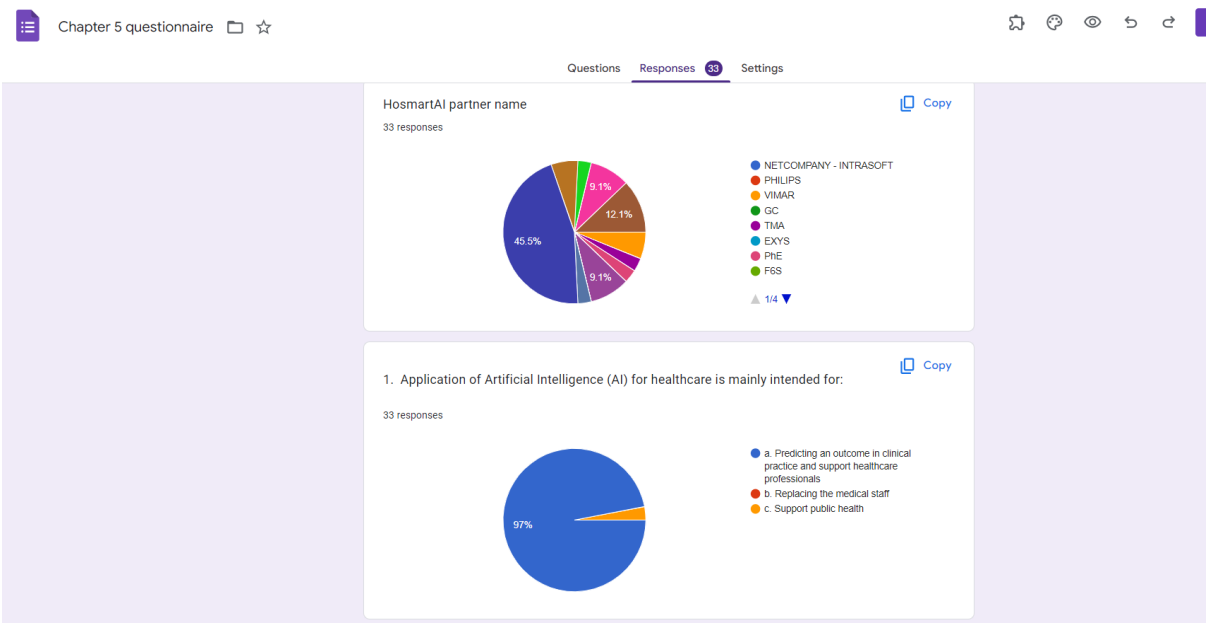
33 responses



- a. Patients and care providers are discouraged from using technology, thus maintaining traditional healthcare practices without changes.
- b. Empowering patients through technology includes increased control over their healthcare, enhanced communication, and the importance of…
- c. Technology reduces communication between patients and healthcare providers, making healthcare less effic…

E.5 Chapter 5


Chapter 5 questionnaire
Questions
Responses 33
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TMA
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F6S
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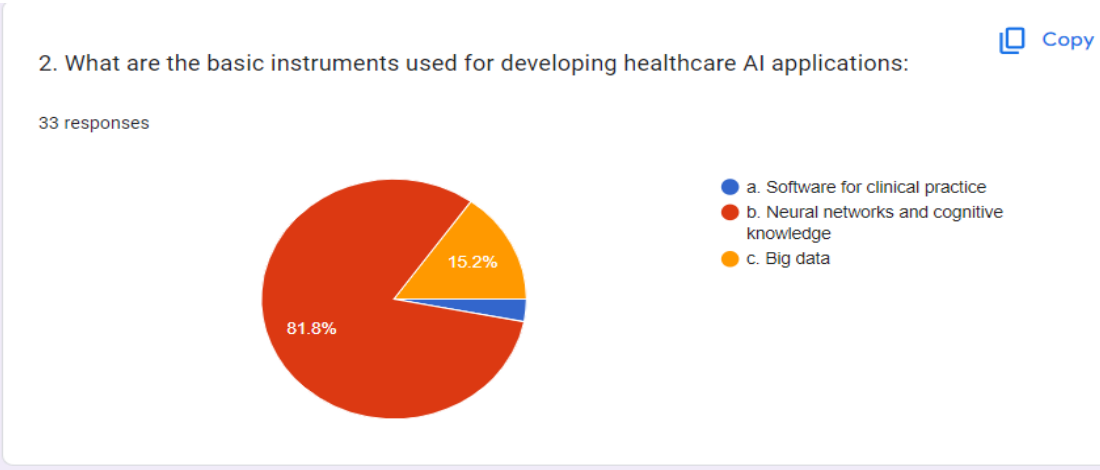
9.1%
12.1%
9.1%
1. Application of Artificial Intelligence (AI) for healthcare is mainly intended for:
Copy
33 responses
a. Predicting an outcome in clinical practice and support healthcare professionals
b. Replacing the medical staff
c. Support public health
97%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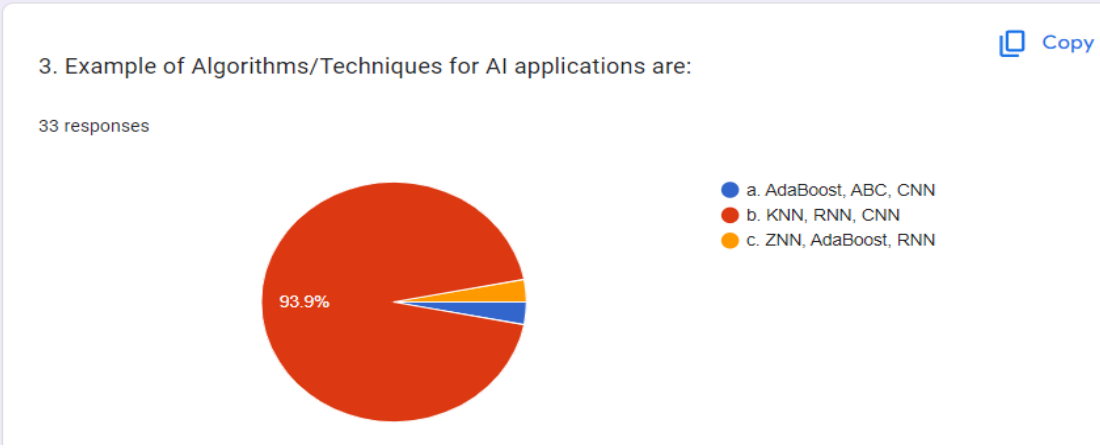
2. What are the basic instruments used for developing healthcare AI applications:
33 responses
a. Software for clinical practice
b. Neural networks and cognitive knowledge
c. Big data
15.2%
81.8%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3. Example of Algorithms/Techniques for AI applications are:
33 responses
a. AdaBoost, ABC, CNN
b. KNN, RNN, CNN
c. ZNN, AdaBoost, RNN
93.9%

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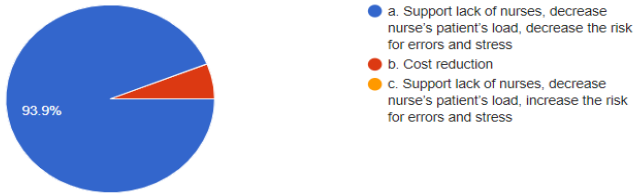
4. AI in nursing will have as benefits

33 responses



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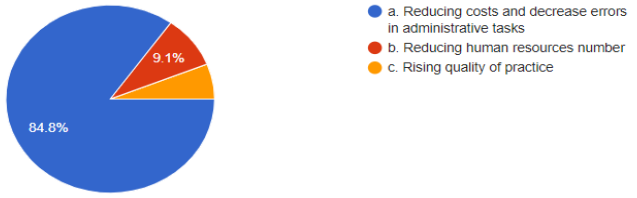
5. AI for healthcare administrative work benefits are:

33 responses



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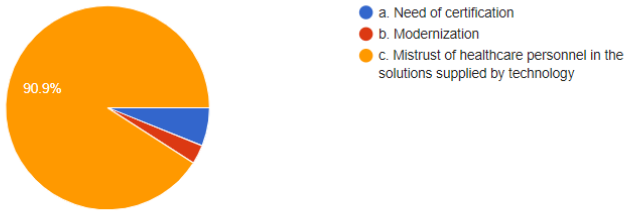
6. Development of Explainable AI (XAI) in healthcare is e consequence of

33 responses



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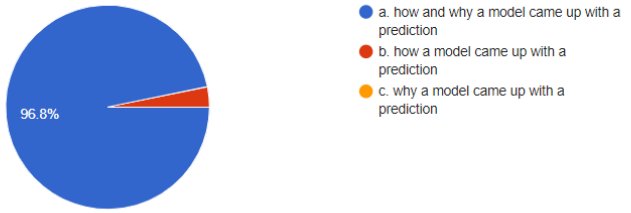
7. Explainability supports healthcare users to understand

31 responses



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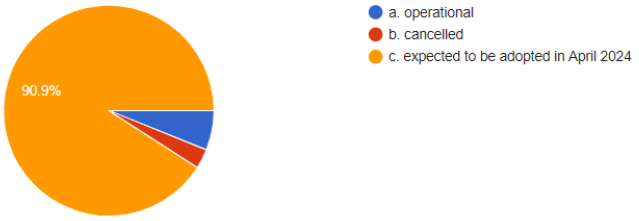
8. The EU's Artificial Intelligence Act is

33 responses



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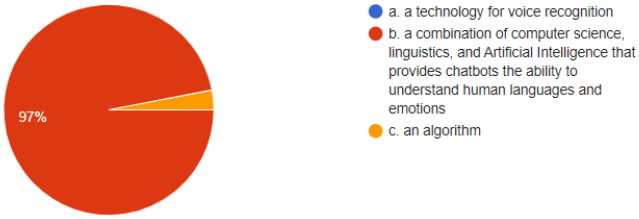
9. NLP is

33 responses



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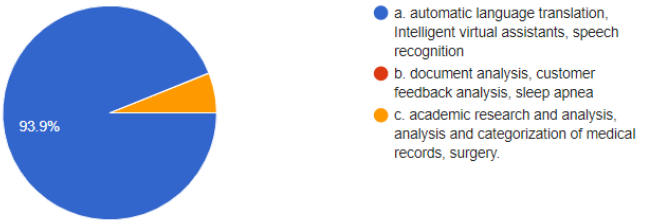
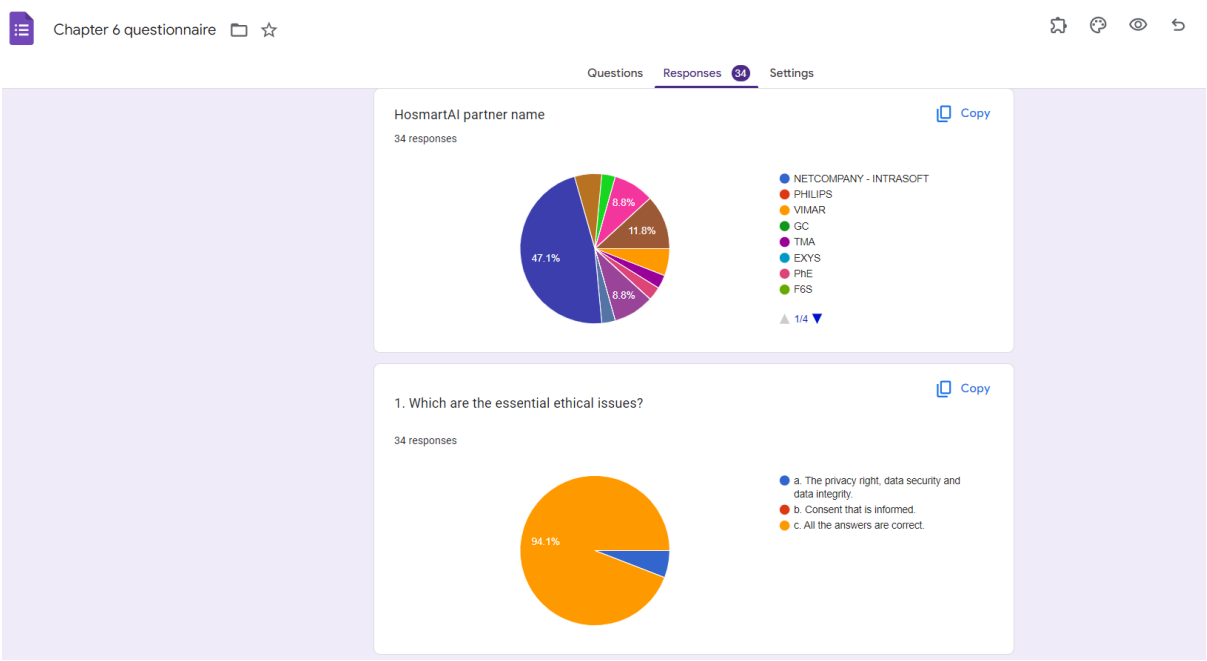
10. NLP is useful for

33 responses



E.6 Chapter 6


Chapter 6 questionnaire
Questions
Responses 34
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34 responses
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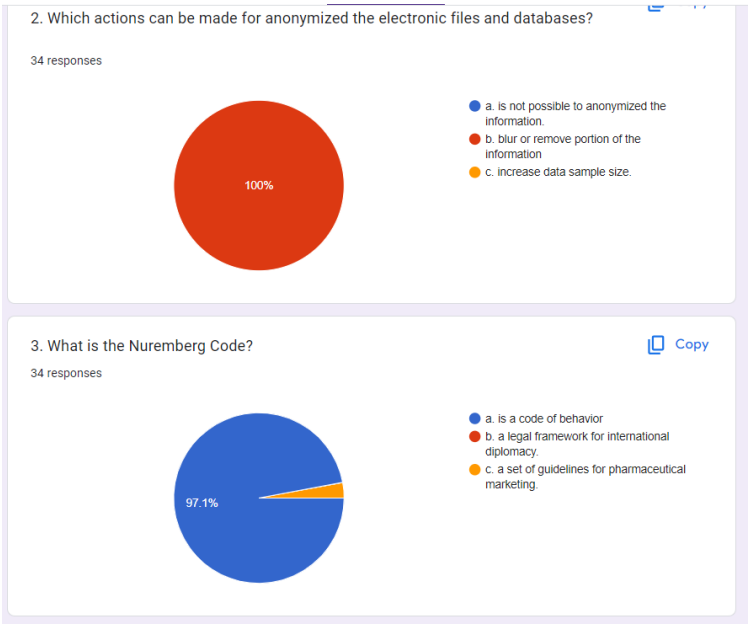
PHILIPS
VIMAR
GC
TMA
EXYS
PhE
F6S
1/4
8.8%
11.8%
47.1%
8.8%
1. Which are the essential ethical issues?
Copy
34 responses
a. The privacy right, data security and data integrity.
b. Consent that is informed.
c. All the answers are correct.
94.1%


2. Which actions can be made for anonymized the electronic files and databases?
34 responses
a. is not possible to anonymized the information.
b. blur or remove portion of the information
c. increase data sample size.
100%
3. What is the Nuremberg Code?
Copy
34 responses
a. is a code of behavior
b. a legal framework for international diplomacy.
c. a set of guidelines for pharmaceutical marketing.
97.1%

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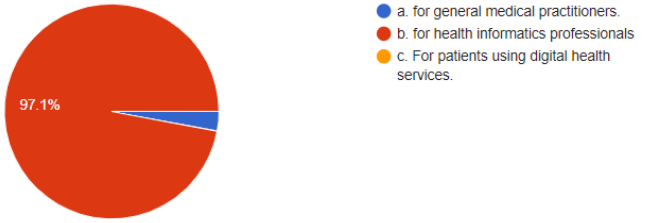
4. For whom is addressed the International Medical Informatics Association's (IMIA) Code of Ethics?

34 responses



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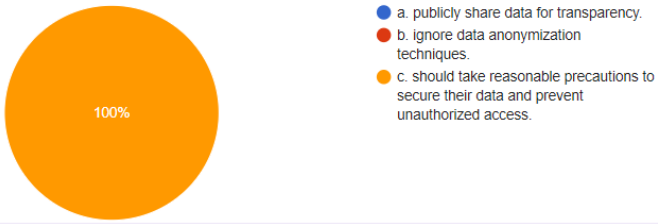
5. What should researchers do to protect patient safety?

34 responses



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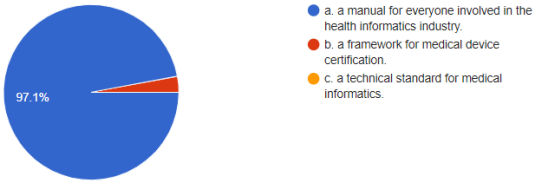
6. What is IMIA Code?

34 responses



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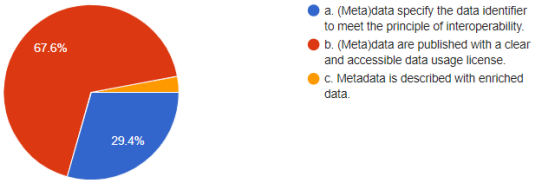
7. Which of these principles is a FAIR principle:

34 responses



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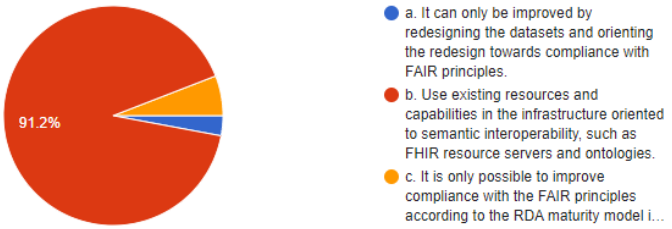
8. What are the drivers that we can use in a healthcare AI infrastructure to improve the level of compliance with FAIR principles if they have not been taken into account in the dataset's design?

34 responses



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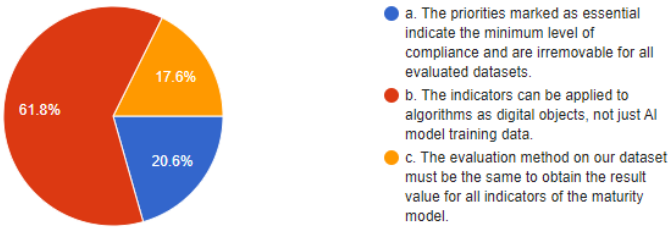
9. Which statements regarding using the Research Data Alliance's FAIR data maturity model are correct?

34 responses



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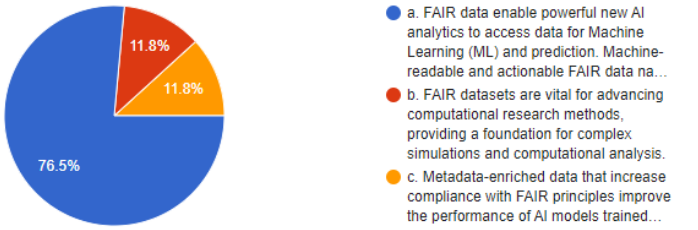
10. Which of these statements makes sense concerning the value contribution of the FAIR principles to implementing AI in healthcare?

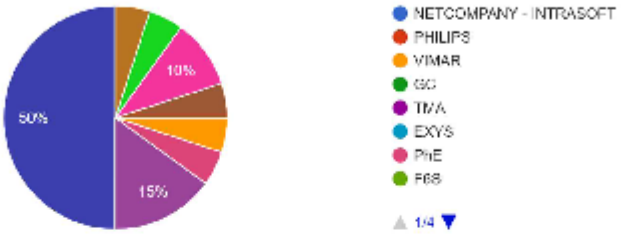
34 responses



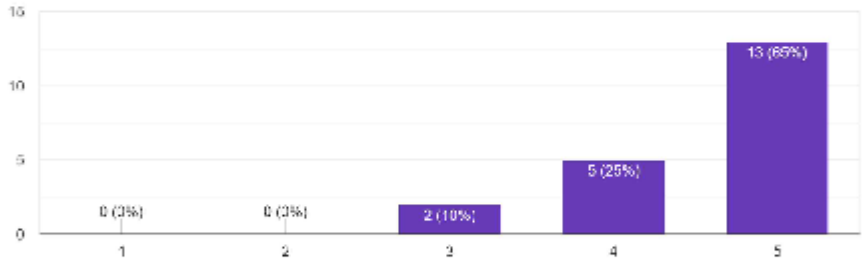
Appendix F Perception after evaluation

Perception after evaluation

HosmartAI partner name
20 responses



1. Has the material from the 6 chapters reached its goal and is it useful for the formation of the profession?
20 responses



Appendix G Certification diploma

Appendix H Certification ceremony


HosmartAI - "Hospital Smart development based on AI", aims to be the most relevant player for the digital transformation of the European healthcare sector, to make the European healthcare system more strong, efficient, sustainable and resilient.
UNIVERSI
MEDICA
INTERNAZIO
NICAMILLUS