

R1.3 AIIS competence guidelines and learning journey

WORKPACKAGE 1



Artificial Intelligence, Innovation & Society, the future of medicine – AIIS

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AIIS Report



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Short Description	<p>This report represents a detailed structure of the learning journey, based on the adaptation of modules listed in WP2 according to the outcomes of R1.2 report.</p> <p>As you will see in this report, the authors in relation to the terminology have taken into account all the modern literature, the official instructions but also the trends and future aspirations at European and global level in relation to the training in Artificial Intelligence, Innovation and Soft Skills.</p> <p>The reason that we focused so much on the terminology is twofold:</p> <ol style="list-style-type: none"> 1. On the one hand students will be trained in the most modern terminology and this will further help them to exploit their knowledge on their profession. 2. On the other hand, the project partners considering also the viability of the project as well as the future exploitation of the project and the need of clarity and the use of EU recognised concepts. After all our goal as a consortium is for the results of the project to be up to date for the future in order to be used as tools by the end users as well as the reports to be a stepping stone for future projects. <p>As you will see in the competence guide we list and describe each competence to ensure this common understanding of each one. Also, those skills are organised and structured to form a list of modules with a first description of the desired contents in each module. The modules are designed to obtain a total of around 60 hours of training online, while the challenges account for 15 hours. Sections of this report will be largely disseminated on the project website (of course in a more visual appealing form) and in WP4 and WP6 activities.</p>



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Table of contents

1 Identifying emerging Digital (AI) and Soft Skills in medicine.....	7
1.1 Introduction.....	7
1.2 Methodology	8
1.3 Digital (AI) Skills.....	10
1.3.1 Identification of AI Skills	10
1.3.2 AI Skills Modules	12
1.4 Soft Skills.....	13
1.4.1 Identification of Soft Skills.....	13
1.4.2 Soft Skills Modules	15
2 The list of modules with a first description of the desired contents.....	16
2.1 Digital (AI) Skills Modules Analysis.....	16
2.2 Soft Skills Modules Analysis.....	29
3 References.....	36



1 Identifying emerging Digital (AI) and Soft Skills in medicine.

1.1 Introduction

In the last two decades the demand for digital skills and soft skills in medicine has multiplied and professionals with these skills can meet the challenges of modern requirements. Artificial Intelligence (AI) is an area of science that focuses on understanding and creating computer algorithms that can perform tasks that are common to humans.

Today, AI is applied to health for faster and more accurate diagnosis, to reduce errors due to human judgment, to reduce medical costs, to assist in invasive surgery, and finally to help reduce mortality rates. The rise of AI in health science and its integration into standard clinical practice is going to be a challenge. Along with changing the conventional ways doctors work, the “black box” problemⁱ and liability issues are some of the most anticipated challenges. Traditional medical school curricula must follow the transition from the “era of information” to the AI-era that emerges.

Prospective physicians need to be taught the ability to effectively integrate and use information efficiently. To integrate this knowledge into medicine, it is essential to start introducing these concepts from the beginning of their training.

In the basic phase of preclinical teaching, must be allocated time to basic principles of AI and ethical and legal issues that arises due to the use of AI. Course work on critical evaluation



and statistical interpretation of AI and Robotic technologies is also important. All of these issues should be taught in stand-alone courses to teach the basics of these topics that can be used even after the current applications are outdated. These stand-alone courses could potentially enhance or even replace the medical IT and statistics courses in the current curriculum.

The digital transformation of medicine and the introduction of digital technologies in all aspects of our daily lives have impacted the world of healthcare by causing tremendous changes in the skills that health professionals must acquire in order to remain competitive.

1.2 Methodology

Our methodology was based to one questioner and four desk research for each country of the project, we had a total of 442 answers to the questionnaire from 4 countries, Greece, Belgium, Finland and Spain. 186 men, 216 women and 6 answered us not to determine their gender. We had a total of 154 responses from Spain, 71 from Finland, 118 from Greece and 65 from Belgium. Of these, 97 are professors and 311 students. Of the 58 professors who answered the question for their years of experience, only 6 professors had experience of less than 5 years and 4 professors of 5 to 10 years, all the rest (48 professors) had professional experience of more than 10 years. The survey of the 4 countries shows the following:

1. The courses of AI in the curricula of medical schools are not a whole. They are made in fragments or not at all. Hence the need for a curriculum that will cover the full spectrum of



AI. It will start with learning the basic concepts and will continue with the applications of AI in medicine. It is crucial to emphasize that the existence of individual AI courses does not offer anything to the students they need to be connected to the physical subject of medicine.

2. Also the Soft skills courses are completely absent (with the exception of Spain), basic skills such as problem solving etc. are ignored.

3. The results of our research are fully in line with the results of the OECD where only a few countries (Belgium, Denmark, Finland, the Netherlands, Norway, Sweden) are considered to have the necessary digital skills and appropriate education and lifelong learning systems, which allow them to make full and timely use of the possibilities and challenges of AI. Research shows that both employees and students often have deficient digital skills and that is why lifelong learning systems (both formal and informal) need to be significantly strengthened to facilitate capacity building and the acquisition of new skills. These skills are needed in the future digital world of AI.

4. Digital integration and the elimination of digital illiteracy in AI is not a sprint, but a marathon that requires strategic planning and coordinated action. Supporting people far from AI is a self-evident obligation of benevolent societies. Digital technologies - having invaded all areas of medicine - are radically shaping the way we live, work and learn. They can thus be an ideal ally for tackling daily stressful challenges. Understanding the issue and taking coordinated action, through lifelong learning, can build more inclusive, fairer and more



sustainable societies, where everyone can make the most of this new digital age, its potential and its capabilities, for a more sustainable development.

1.3 Digital (AI) Skills

1.3.1 Identification of AI Skills

Based on an aggregation from online searches examining current AI techniques, practices and trends across all business and industry sectors, we compiled a comprehensive list of desirable AI skills and topics for those wishing to enter the job market in this space. These competencies include:

1. Machine Translation (MT)
2. Machine Vision
3. Artificial Intelligence
4. Automatic Speech Recognition (ASR)
5. Deep Learning
6. Computational Linguistics
7. Computer Vision
8. Decision Trees
9. Natural Language Processing (NLP)
10. Natural Language Toolkit (NLTK)
11. Nearest Neighbor Algorithm
12. Neural Networks



13. Object Recognition
14. Image Processing
15. Image Recognition
16. Pattern Recognition
17. Random Forests
18. Recommender Systems
19. Semantic Driven Subtractive Clustering
20. Semi-Supervised Learning
21. Sentiment Classification
22. Speech Recognition
23. Supervised Learning (Machine Learning)
24. Machine Learning
25. Support Vector Machines (SVM)
26. TensorFlow
27. Agents
28. Text Mining
29. Text to Speech (TTS)
30. Unsupervised Learning
31. Symbolic AI
32. Turing Test



1.3.2 AI Skills Modules

We then set about refining our list by combining related techniques into broader categories and removing those which are not applicable to the medical sector, in turn, leading to this shorter list of AI techniques that we posed in our questionnaire. Our questionnaire presented these techniques and asked medical professors, doctors, and post-graduate students to evaluate what they thought were the most relevant (in-demand) AI topics currently applicable to the medical sector:

1. Inferencing and expert systems
2. Machine learning and related AI techniques.
3. Heuristics and fuzzy logic
4. Image recognition and related AI techniques
5. Natural language processing
6. Other... please specify

The survey analysis suggested expert systems, machine learning and image recognition to be the most pertinent AI techniques for medical professionals. Our analysis also revealed that the level of knowledge should not be to the point where medical students are able to develop their own solutions, but rather remain at application-level comprehension of the AI they will use as medical professionals, whereby they are able to:

1. Understand the underlying architecture of relevant AI techniques
2. Provide the correct input format and interpret the output of relevant AI techniques
3. Critically evaluate the application of relevant AI techniques.



Together with this information, we further scrutinized the survey results and reached consensus among our internal project subject matter experts that we should include the following AI modules into the AIIS project course:

1. Introduction to Artificial Intelligence
2. Introduction to machine learning
3. Expert systems and their role in the healthcare sector
4. Machine learning in the healthcare sector
5. Introduction to machine vision
6. Image recognition in the healthcare sector

1.4 Soft Skills

1.4.1 Identification of Soft Skills

Based on the analysis of all 4 countries in the questionnaires and the second survey, we end up with the following list of soft skills needed in order to a student should be able to:

1. Collect, organize, and visualize information with technology programs and produce creative digital artifacts to convey understanding and inform audiences.
2. Collaborate in constructing technology-enhanced models, preparing publications, and producing other creative works.



3. Understand that spreadsheets, databases, and other similar digital tools are used to collect, organize, process, analyze, and visualize real-world data.
4. To create and edit files in various formats,
5. Understand that a problem can have many solutions, and that solutions can be adapted or modified to solve similar problems using modeling, simulation, creating prototypes and by refining solutions after testing.
6. Determine what is known and what needs to be known regarding a problem and develop a problem statement in order to solve a problem or complete a task.
7. Identify complex, interdisciplinary, and real-world problems that can be solved computationally.
8. Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding, and systems thinking.
9. Create and interpret visual representations such as flowcharts and diagrams to organize data, find patterns, make predictions, or test solutions.
10. Collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.
11. Identify algorithms in everyday life
12. Determine how algorithms can be used to accomplish tasks and solve problems.
13. Understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.



1.4.2 Soft Skills Modules

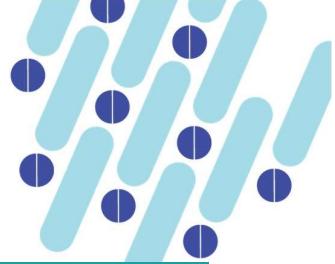
The above Soft Skills are transformed in the following modules:

1. Self- Knowledge and initiative
2. Capacity to adapt to different situations
3. Communication
4. Teamwork
5. Work Organization
6. Work Ethic



2 The list of modules with a first description of the desired contents

2.1 Digital (AI) Skills Modules Analysis



Module 1

1	Module title	Introduction to Artificial Intelligence
2	Module description	This course introduces the fundamentals of artificial intelligence. It will be an overview of the basic principles, techniques, and applications of Artificial Intelligence. The purpose of this module is to present students with a basic general understanding of the field of AI.
3	Learning outcomes (LOut)	<ol style="list-style-type: none"> 1. Share knowledge about the historical development of the field 2. Explain basic concepts and assumptions underpinning key AI techniques 3. Describe the architecture behind common AI systems 4. Identify various AI techniques and match them to their respective application areas or use cases with emphasis on the medical sector
4	Language	<i>English and all the Partners' Languages</i>
5	ECTS\Hours	<i>2 Hours</i>
6	Key words	<i>Artificial intelligence; Turing test; Machine learning; Problem solving; Knowledge representation; Machine vision</i>
7	Content of the module	The module deals with problems faced across multiple industries, with a strong focus on the medical sector, and how artificial intelligence has shaped the way industry addresses their respective challenges. The module contains 3 mini tasks with



	accompanying theory to provide students with a solid overview of AI in general and where it is applied in the medical sector.
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Module 2

1	Module title	Expert systems and their role in the healthcare sector
2	Module description	This module is an introduction to expert systems. The purpose of this course is to cover a broad range of topics relevant to computer assisted techniques for biomedical decision making and intends to give a broad overview of the complex area of decision support systems and their uses in medicine.
3	Learning outcomes (LOut)	<ol style="list-style-type: none"> 1. Present an outline of the history of expert systems in the healthcare sector 2. Understand and explain the functioning of the different components of an expert system 3. Describe the most prominent expert systems currently in use in the healthcare sector 4. Rationalize potential application areas for expert systems in the healthcare sector.
4	Language	<i>English and all the Partners' Languages</i>
5	ECTS\Hours	<i>6 hours</i>
6	Key words	<i>Expert systems; Knowledge-based systems, Rule-based representation, Inferencing; Heuristics; Interpreter; MYCIN; PUFF; CADUCEUS</i>
7	Content of the module	The module deals with the nature of expert systems and how such knowledge-based systems have been integrated into the medical sector through time. The module contains theory in the form of informative videos and infographics with seven mini



	tasks that confirm the student's knowledge regarding the: (a) theoretical foundations; (b) basic components; and (c) application of expert systems in the medical sector.
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Module 3

1	Module title	Introduction to machine learning
2	Module description	This module provides a practical introduction to machine learning. The module presents students with the key components of machine learning architecture and how various algorithms fit into the ML pipeline to produce results in the form of prediction models. The module will also demonstrate how to critically interpret the most common forms of ML output.
3	Learning outcomes (LOut)	<ol style="list-style-type: none"> 1. Formulate a high-level view of machine learning architecture 2. Differentiate between a wide variety of learning algorithms 3. Identify the elements of a learned model and understand their impact on the model output 4. Assess the obtained accuracy of a machine learned model
4	Language	<i>English and all the Partners' Languages</i>
5	ECTS\Hours	<i>5 hours</i>
6	Key words	<i>Machine learning; Data mining; Classification; Regression; Correlation; Statistical modelling; Decision trees;</i>
7	Content of the module	The module sketches an overview of machine learning in the general sense through an explanation of the pipeline architecture that leads to various possible ML outputs. Students will receive theory content in the form of narrated ML model animations, informative videos and infographics. The module further comprises five mini tasks



students must complete to confirm their general understanding of ML and its respective components.



Module 4

		Module 4
1	Module title	Machine learning in the healthcare sector
2	Module description	This module will introduce the fundamental concepts and principles of machine learning as it applies to medicine and healthcare. The module begins with an introduction to clinical data, and then explores the use of machine learning for risk stratification and diagnosis, disease progression modeling, improving clinical workflows, and precision medicine. The module will also present key ethical dilemmas that the application of ML in the medical sector brings forward.
3	Learning outcomes (LOut)	<ol style="list-style-type: none"> 1. Identify and explain the influence of machine learning on the healthcare sector 2. Describe how health information management can benefit from machine learning 3. Argue the benefits and drawbacks of applying machine learning to a healthcare related problem space 4. Take an ethical stance for or against applying machine learning to a given healthcare problem area
4	Language	<i>English and all the Partners' Languages</i>
5	ECTS\Hours	5 hours



6	Key words	<i>Machine learning; Deep learning, Artificial neural networks; Text analysis, Data analysis, Classification; Linear classification; Regression; Diagnosis; Prediction; ethics;</i>
7	Content of the module	The module provides students with various formats of theory content that covers ML from the perspective of: (a) data and decisions in Medicine. The module also introduces more complex topics such as deep learning and neural networks and how these are deployed in the medical sector. Specific attention is given to the role ML plays in diagnosis, predicting disease pathways and personalized treatment. Students will complete five mini tasks to confirm their learning.



Module 5

1	Module title	Introduction to machine vision
2	Module description	This module introduces computer vision as a field of artificial intelligence that deals with computational methods to help computers understand and interpret the content of digital images. The module presents various computer vision algorithms and explains each of their proficiencies at deriving meaningful information from both video and static images in the context of real-world problem solving.
3	Learning outcomes (LOut)	<ol style="list-style-type: none"> 1. Formulate a high-level view of computer vision architecture 2. Discuss the extraction and tracking capabilities of computer vision involving image and video data 3. Differentiate between a wide variety of computer vision algorithms 4. Express how existing computer vision algorithms can be applied to real-world problems involving image and video data.
4	Language	<i>English and all the Partners' Languages</i>
5	ECTS\Hours	<i>4 Hours</i>
6	Key words	<i>Computer vision, Digital vision architecture, Digital visual input; Object detection; Scene reconstruction; Signal processing; Data transformation</i>



7	<p>Content of the module</p> <p>The module contains various formats of theory content, including narrated animations, informative videos, infographics, and posters that explain the: (a) architecture; (b) common types of data transformation possibilities; and (c) most applicable real-world applications of a typical machine vision system. Students will have to complete five mini tasks to confirm their understanding of machine vision how it sets out to mimic and outperform human vision in given cases.</p>
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Module 6

1	Module title	Image recognition in the healthcare sector
2	Module description	This module covers various aspects of image recognition and how these have shaped current imaging techniques used in the healthcare sector, with a particular focus on image recognition diagnostics. The module also suggests possible benefits to patient care through facial recognition for patient admittance processes, emotion detection and health mirroring.
3	Learning outcomes (LOut)	<ol style="list-style-type: none"> Report on both well-established and new medical imaging techniques and approaches Identify and explain the influence of image recognition on the healthcare sector Discuss how diagnostics can benefit from image recognition Appraise the application of facial recognition to patient care
4	Language	<i>English and all the Partners' Languages</i>
5	ECTS\Hours	<i>5 Hours</i>
6	Key words	<i>Image recognition, Facial recognition, Image classification, Image analysis, Image segmentation; Diagnostics; Medical imaging; Health mirror</i>



7	Content of the module	<p>The module contains a series of short theory content artefacts that explain the past and current state-of-the-art image recognition techniques used within the healthcare sector and how these have influenced a variety of tasks within the sector. The module goes on to unpack how diagnostics and peripheral patient care activities have undergone major transformation by presenting several key technology use cases for image revisualization and facial recognition respectively. The student will complete five mini tasks to confirm their learning.</p>
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2.2 Soft Skills Modules Analysis

Module 1	
1	Module title
2	Module description
3	<p>Learning outcomes (LOut)</p> <p>At the end of this module, the learner should be able to:</p> <ul style="list-style-type: none"> • Define realistic and concrete objectives. • Identify what prevents her/him to achieve her/his goals. • Learn techniques that allow her/him to motivate her/himself in difficult situations. • Know effective strategies to prevent stress and improve emotional self-control. • Control negative thoughts that generate worry, anxiety or stress. • Become aware of her/his own thinking mechanism and know other methods that allow her/him to improve thinking skills that facilitate the construction of mental schemes and lifelong learning. • Know good habits that enhance personal well-being and health.
4	Language
5	ECTS\Hours
6	Key words



7	Content of the module	<ol style="list-style-type: none"> 1. Self-motivation 2. Initiative, proactivity, and good attitude to work 3. Self-confidence and auto control 4. Metacognitive skills
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Module 2		
1	Module title	Capacity to adapt to different situations
2	Module description	Medicine is a field that is quite stressful whether we are talking about working in a hospital or even in a laboratory. This is why this module focuses on developing in future health professionals the ability to cope with a variety of situations, whether they involve teamwork, the use of new tools or tasks that they have to manage for the first time.
3	Learning outcomes (LOut)	<p>At the end of this module, the learner should be able to:</p> <ul style="list-style-type: none"> • Identify the process of change. • Know different techniques that help her/him to prioritize and adapt her/his own plans and behaviors to new situations. • Identify and manage the different emotional states generated by changes (including resistance to change), incorporating emotional techniques and tools to deal with situations of change in a constructive way. • Approach novel situations as a challenge and not as a problem (develop resolute attitudes), identifying the possibilities for change and continuous improvement.



4	Language	<i>English and all the Partners' Languages</i>
5	ECTS\Hours	<i>5 Hours</i>
6	Key words	<i>Resilience, Stress Tolerance, Flexibility</i>
7	Content of the module	<ol style="list-style-type: none"> 1. Capacity to adapt to different situations (teams, tools, tasks, etc) 2. Resilience, stress tolerance and flexibility

Module 3

1	Module title	Communication
2	Module description	Communication is one of the most relevant skills that medical students need to acquire. It is very important that they know how to properly express their thoughts and work, whether they refer to patients or present their achievements to members of their team, to groups of other specialties, and even to the general public. In their professional career they will need to have empathy as well as assertiveness in order to convey their findings correctly but also in an understandable and compassionate way.
3	Learning outcomes (LOut)	<p>At the end of this module, the learner should be able to:</p> <ul style="list-style-type: none"> • Apply communication techniques that allow her/him to have more connection with the patient, family, colleagues and the general public. Among them, assertiveness, empathy. • Have a presence in communication and eliminate communication barriers, such as prejudices. • Use some strategies to communicate diagnoses and bad news clearly, concisely and understandably.



		<ul style="list-style-type: none"> • Know guidelines that help writing of the ideas, so that they are understood and generate interest in the receiver. • Recognize the keys that lead to improving success in presentations, and learn some tools that allow them to generate the interest and understanding of the audience (regardless of whether it is a large or small audience). • Apply emotional self-management techniques to improve performance in presentations.
4	Language	<i>English and all the Partners' Languages</i>
5	ECTS\Hours	5 Hours
6	Key words	<i>Communication, Expressing ideas, Assertiveness, Empathy, Oral Communication</i>
7	Content of the module	<ol style="list-style-type: none"> 1. Efficient communication with patients and family 2. Ability to express ideas in writing (reports, emails, etc) 3. Oral communication: assertiveness and empathy 4. Efficient presentation (small and big audiences) 5. Efficient presentation general public/layman's terms

Module 4

1	Module title	Teamwork
2	Module description	Teamwork skill will allow them to work together in a well-defined but at the same time open to new ideas environment. Especially when it comes to people and groups that include people from other fields of education, these skills are very important in order to make the right decisions and to solve problems effectively, while at the same time,



		when needed, to be able to negotiate and present arguments, in an understandable way.
3	Learning outcomes (LOut)	<p>At the end of this module, the learner should be able to:</p> <ul style="list-style-type: none"> • Argue the characteristics of an effective team (differentiate it from a group), the skills and activities that are required to achieve effective Multi / inter / transprofessional work teams in the field of health. • Explain the advantages of teamwork, the phases a team goes through to become an effective team. • Know the keys to identifying and managing a conflict within a team. • Know the different negotiation techniques as a strategy for the resolution of conflicts that may arise between Multi / inter / transprofessional teams. • Know the keys that the team leader must take into account to build a decisive and effective team.
4	Language	<i>English and all the Partners' Languages</i>
5	ECTS\Hours	<i>5 Hours</i>
6	Key words	<i>Teamwork, Problem Solving, Decision-Making, Cooperation, Negotiation, Persuasion</i>
7	Content of the module	<ol style="list-style-type: none"> 1. Teamwork and cooperation 2. Problem solving and decision-making 3. Negotiation and persuasion 4. Multi/inter/transprofessional-disciplinary collaboration



Module 5

1	Module title	Work Organization
2	Module description	This module provides an introduction to the fundamentals of Work Organization in nowadays. It is crucial for medical students to know how the modern management works. More specifically they will learn about agile management, innovation management and the usage of project management tools for time management.
3	Learning outcomes (LOut)	<p>At the end of this module, the learner should be able to:</p> <ul style="list-style-type: none"> • Use organizational planning and work time management improvement methods focused on health care. • Identify the internal and external obstacles that really prevent her/him from managing time efficiently. • Know some tools that allow a better organization of work and optimization of time. • Recognize and apply some strategies to improve concentration at work. • Design a personalized plan of action for organization and time management.
4	Language	<i>English and all the Partners' Languages</i>
5	ECTS\Hours	<i>5 Hours</i>
6	Key words	<i>Agile Management, Time Management, Innovation Management, Project Management Tools</i>
7	Content of the module	<ol style="list-style-type: none"> 1. Effective work organization 2. Efficient and effective time management



Module 6

1	Module title	Work Ethic
2	Module description	Medicine is a human-centered science and medical professionals must have a strong background in work ethics. This module will train them to make appropriate ethical responses to everyday situations but not limited to.
3	Learning outcomes (LOut)	<p>At the end of this module, the learner should be able to:</p> <ul style="list-style-type: none"> • Understand the practice of medical ethics in the physician's daily work. • Analyze ethical issues in healthcare practice and to discover the physician's appropriate responses to everyday situations. • Evaluate the effects that the absence of medical ethics produces in professional practice. • Recognize and handle errors, investigating their causes to avoid them in the future and take advantage of them. • Rationalize on Science vs humanity in medicine: becoming aware that biomedical science and clinical ethics are complementary, mutually demanding. • Reflect on the future of medical ethics especially in the field of artificial intelligence.
4	Language	<i>English and all the Partners' Languages</i>
5	ECTS\Hours	<i>5 Hours</i>
6	Key words	<i>Work ethic, ethical medicine, Ethics and AI, Humanity in Medicine</i>



7	Content of the module	<ol style="list-style-type: none"> 1. Professional code of conduct 2. Ethical guidelines
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