

## Title

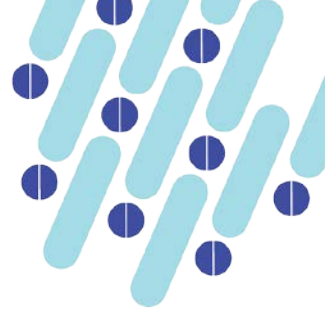
WORKPACKAGE 1: Research on Training methods,  
Artificial Intelligence and soft skills in medicine studies  
(Short Version)



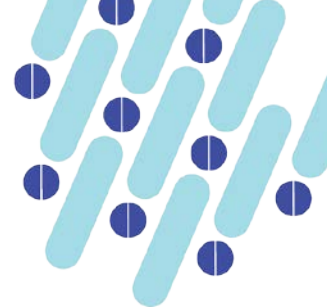
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**Artificial Intelligence, Innovation & Society, the future of  
medicine – AIIS**

<b>Author(s):</b>	UNIVERSITY OF THESSALY
<b>Editor(s):</b>	Yiannis Kiouvrekis, Vassiliki Softa, Pedro Luis Sánchez, Emiliana Pizarro, María Jesús Santos
<b>Responsible Organization:</b>	UNIVERSITY OF THESSALY

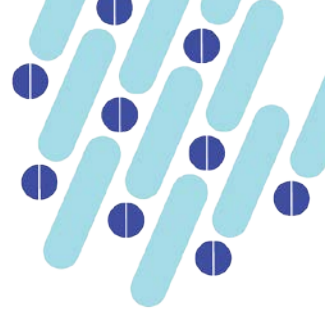


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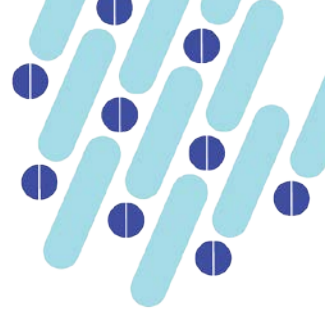


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<b>Short Description</b>	<p>In this report, with the contributions of all partners working together within each country (national groups for Spain - Greece - Benelux - Finland), a study it is been made of the state of development of the AI and soft skills in healthcare education in each of the countries represented in the AIS consortium, with a special attention given to the definition of the AI and its application, the need for soft skills, but also a focus on learning and teaching methods mostly used to address such skills needs. This report also includee survey and desk research results. HEIs performed an analysis of the state of the art of training of AI and soft skills in medicine curriculums in the different partner countries. Thus, R1.2 describes the educational system of each country, identifying their state of the art in terms of education with concrete examples that support the development of this sector through the training of future professionals. In addition, other partners provided information on other forms of continuous training and how professionals normally acquire those skills. The survey provides important information, giving an insight on the perception</p>



	of the different target groups of the project on this issue. The survey it is annexed to this output with full results.
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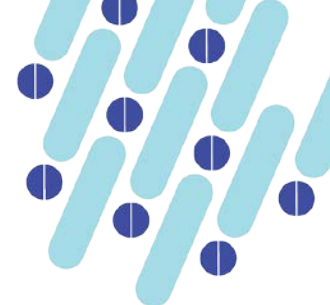
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<b>1.</b>	Coordinator	University of Salamanca	USAL	Spain
<b>2.</b>	Partner	MARKEUT SKILLS SL	MEUS	Spain
<b>3.</b>	Partner	CIBER	CIBER	Spain
<b>4.</b>	Partner	UNIVERSITY OF MONS	UMONS	Belgium
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<b>7.</b>	Partner	SCIFY	SciFY	Greece
<b>8.</b>	Partner	TURKU UNIVERSITY OF APPLIED SCIENCE	TUAS	Finland
<b>9.</b>	Partner	TURKU UNIVERSITY	UTU	Finland

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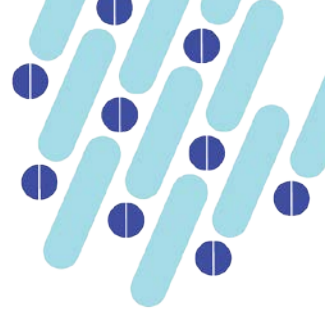
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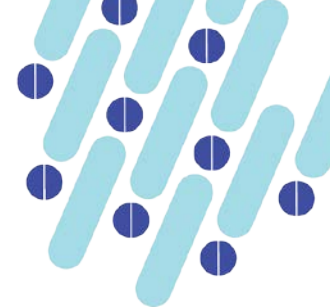


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## 1. Introduction

The aim of this paper is to present the main results of the AIIS research process in the context of the first work package. The methodology used is based on the program guide and more specifically the University of Thessaly guided all partners to provide collaborative contributions from each country (national groups for Spain - Greece - Benelux - Finland), to produce this report.

This report contains the results and their analysis based on a questionnaire which was given to the Universities of the consortium and was constructed with the aim of extracting the basic needs in the field of health professionals on AI and soft skills in healthcare education, with a special attention given to the definition of the AI and its application, the need for soft skills, but also a focus on learning and teaching methods mostly used to address such skills needs.

Also, this report is including the desk research results, where each country partner has described his/her educational system, identifying their state of the art in terms of education with concrete examples that support the development of this sector through the training of future professionals.

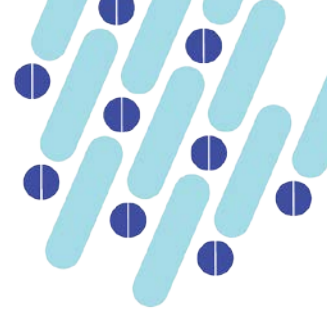
## 2. Methodology

The methodology we used in the construction of the questionnaire was based on one hand on the scientific principles of research methodology and on the other hand on the broader consensus of all partners on the type and number of questions. The questionnaire and the responsibility of collecting the data was in the Universities of the consortium.

As far as desk research is concerned, its structure is starting with a focus on the skills a student should have related to AI and soft skills to better his/her performances as a professional. The University of Thessaly and the contributor partners have taken care in the vocabulary used to describe the desired skills, based on the future exploitation of the project and the need for clarity and use of EU recognized concepts.

The survey will provide important information, giving an insight on the perception of the different target groups of the project on this issue. The survey will be annexed to this output with full results. The purpose of this report is to present the results of the statistical analysis of the questionnaire. A separate analysis was carried out for the





answers given by each country and specialization (professor, student, etc.). The questionnaire was answered by 442 people from 4 countries and the questions referred to the knowledge that the respondents had about artificial intelligence as well as about their soft skills.

### 3. Comparative Analysis – The short analysis

Analyzing the questionnaire, we came to the conclusion that in individual questions there were variations in the majority of answers, however there are common points between all four countries. This is explained by desk research since the structures of the curricula and the policies they follow in matters of artificial intelligence in health, are similar. The only exception that is observed is that in Greece where the national policy is being drafted on issues related to artificial intelligence. Analyzing the questionnaire showed very interesting results. Initially, teachers were much more conservative than students in what they thought they knew about artificial intelligence, which is common in all countries. As far as students are concerned, the students of Greece seem to have the greatest self-confidence compared to those of the 3 other countries. Let us emphasize here that this confidence does not arise from a curricula particularly oriented to AI, Greece being the only country that does not have a national policy on artificial intelligence.

Regarding the comparative analysis of undergraduate and postgraduate national curriculum, we were led to the following results.

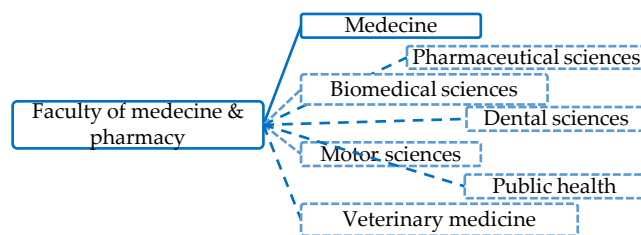
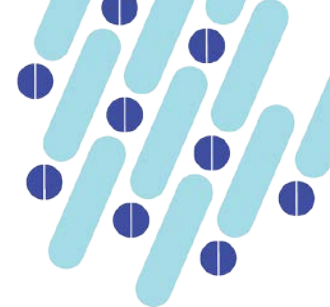


Table 1: Faculty of Medicine & Pharmacy

Faculties of medicine and pharmacy generally include medicine (clinical sciences), pharmaceutical sciences, dental sciences, biomedical sciences, veterinary medicine, motor sciences and public health.

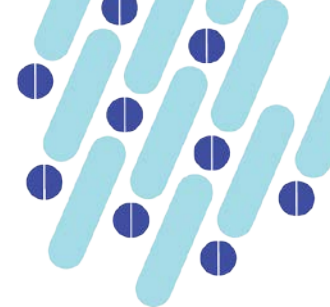


## a. Medical Studies in Belgium

Becoming a Doctor of Medicine (MD) in Belgium means following basic medical training consisting of a 180 credits bachelor's and a 180 credits master's degree. According to the Belgian medical legal system, additional residency training in combination with an advanced master's education is compulsory to become active as a professional physician who can and may practice medicine at his or her own responsibility within the Belgian legal and social security framework. The medical curricula in Belgium have almost no differences compared to other curricula around the world. They have the same timeframe for the whole degree program which is 6 years long (3 bachelor + 3 master) with an extra two years to become a general doctor or 3 to 6 years to become a specialist. However, the arrangement or the order of the topics that will be taught and discussed is different for every university.

The Federal Government of Belgium launched AI4Belgium the Belgian coalition for AI. Among them, a specific AI4Health working group aims to promote the implementation of AI in healthcare and AI education in medicine. The AI4Belgium coalition recommends developing a responsible data strategy where trust is the cornerstone of any transformation, while a robust and up-to-date legal framework, ethical principles and more transparency are needed. Also, the Secretary of State for Digitalization has launched "Digital Minds" to tackle the broader digital sense. Among these Digital Minds, health is included in government competences in specialized "Councils" (each council represents a pillar - government, industry, etc.). Digital Minds and AI4Belgium work very closely together.

In the Belgian Walloon region the DigitalWallonia4.ai program has the objective of accelerating the adoption of AI in the region. The overall budget, which also includes industry 4.0 and the regional digital strategy "Digital Wallonia", is 18 million EUR per year. Since December 2020, the regional AI program includes a research project called "ARIAC by DigitalWallonia4.ai" launched in the framework of the TRAIL consortium, which brings together universities and research centers in the Wallonia-Brussels Federation. The 32 million EUR project is funded by the Walloon Region and runs from 2021 to 2026.



The Belgian Flemish Government launched the Flemish action plan to foster AI in Flanders. The Flemish AI action plan foresees an annual budget of EUR 32 million for its implementation, broken down as follows: EUR 15 million dedicated to the implementation of AI within companies, EUR 12 million allocated to basic research, and EUR 5 million to supporting measures (training, ethical and legal aspects related to AI-adoption, and outreach activities). This funding is complemented with other policy instruments of both FWO (funding for HEIs) and VLAIO (funding for enterprises). In 2020 FWO invested about EUR 15 million and VLAIO some EUR 45 million in AI related projects. The same amounts are expected for the following years. The Flemish AI policy plan also draws particular attention to the development of AI for the healthcare sector. In line with the Flemish policy plan for 2019-2024 and the framework of Flanders Care, a specific focus is given to support new cooperation models between the public health care sector and the industry. Agoria has recently launched an AI-MOOC for the health sector. For the Brussels-Capital Region, the innovation funding body Innoviris has been playing a major role in the support of AI-related research and innovation efforts in Brussels. All these regional initiatives are joined up at the level of AI4Belgium.

#### b. Medical Studies in Finland

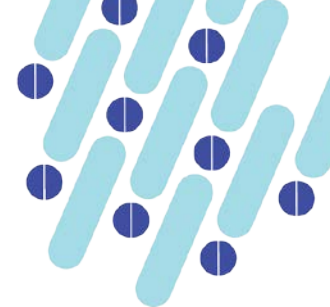
University level medical education in Finland takes place in the Medical Schools in the Faculty of Medicine (University of Turku, Helsinki and Oulu) or the Faculty of Health Sciences (Eastern Finland) or the Faculty of Medicine and Health Technologies (Tampere). Below, all these Medical School home bases are commonly referred to as “Faculty of Medicine”. In **Medicine** or **Dentistry**, the degree in Finland consists of 12 or 11 semesters, respectively. This means 6 or 5,5 years of full-time studying. The curriculum consists of preclinical (2-3 years) and clinical studies in the Universities of Turku, Helsinki, Oulu and Eastern Finland. Tampere University applies a problem-based learning pedagogy and, thus, preclinical and clinical studies are taught together. In all the Finnish Universities the curriculum of medicine consists of 360 ECTS and dentistry of 330 ECTS, similarly to other European Universities. Most of the studies are fixed and harmonized across the medical faculties, based on the core learning objectives. However, there are a few ECTS for optional (elective) studies included



(about 10-30 ECTS, depending on the university). The Master's degree in Health Sciences consists of 4 semesters, which means two years of full-time studying. The curriculum for Master in Health Sciences contains 120 ECTS. Studies are offered mainly in Finnish language but in most universities, some courses are offered in English as well. Students can choose to specialize in nursing leadership and management with expertise in several clinical areas or in health education and the didactics of nursing science (teacher training). The offered programs and the options for specializing vary by different universities. The contents of the curricula for Bachelor in Health Sciences and Master in Health Sciences are different, depending on the university. The courses teaching AI vary a lot depending on the University, and the particular topic. Currently, AI courses evolve rapidly, incited by the real life needs and new technology developed for the use of health care sector and medicine & dentistry. Thus, the need for such courses is imminent, both the more general and in-depth courses.

Medical school may have other names like “Health sciences faculty”. Other health sciences grade like nutrition, biomedicine, biomedical engineering, etc., may be taught in this faculty.

The previous government (2015 – 2019) of Finland made artificial intelligence (AI) as one of its key projects. The Minister of Economic Affairs launched the Artificial Intelligence Programme in May 2017. Later in the same year, the first eight key actions were presented for making Finland one of the leaders in the application of AI. This work was later supplemented with separate analyses and recommendations for measures on the future of work, ethics and security. Finland's stability and security combined with high technology utilisation rate and education level provide an excellent platform for the creation and development of digital business. The development of data policy and data management in a way that takes the different life situations of citizens into account is a unique innovation by global standards. In addition to the policy making ministries of the central government of Finland, several universities and other research institutions have actively contributed to the discussion about the policy making principles for AI, such as the Helsinki Centre for Data Science (HiDATA), University of Helsinki Legal Tech Lab and the Finnish Center for Artificial Intelligence (FCAI).

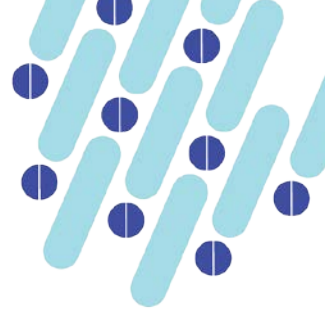


### c. Medical Studies in Spain

The grade in medicine in Spain consists in a 6-years degree. The national curriculum ([link](#)) consists in a list of core subjects with their respective ECTS that must be included in the particular curricula of each university. This national core curriculum has a total of 160 ECTS, so each university has room to include in their curricula the subjects they may consider since the grade usually has a total of 360 ECTS. There is not a unique curriculum concerning the post graduate studies. Each official master degree is designed by the university and then approved by an academic comision of the region and the Minister of Education. Regarding the masters for graduates in medicine, there are degrees related with many medical specialities, and the majority of the medical schools have a master in biomedical research, mainly oriented for future doctoral students. As for the post-graduate curricula, excepting the titles about biomedical research, we found very different curricula. Most of the masters are focused on different biomedical specialties, but some of them are more transversal with topics like healthcare systems management.

Generally, the courses are broad and not only focused on a particular topic. The courses are oriented to the teaching of a topic related to AI or soft skills and the application to the healthcare area. For example, in the 1.2.1 course, there are contents about R programming, but they are oriented and combined with the analysis of omics data.

Estrategia Española de Ciencia, Tecnología e Innovación 2021-2027: Among the strategic lines we can find “precision medicine” and the following sublines, “artificial intelligence” and “digital health in personalized medicine”. “Artificial intelligence and robotics” is also a strategic line on its own, including “computer vision” and “digital health” as sublines. Estrategia Española de I+D+i en Inteligencia Artificial: Describes primary care as a sector which will benefit from AI, and the focus in cost savings through improvements prevention, early diagnosis and treatment of child obesity, cardiovascular diseases, neurogenerative diseases and breast cancer, among other subjects. It states the need for an AI able to explain its decision to health professionals and improving the interaction human-computer. “P4 medicine” (predictive, personalized, preventive and participative) will be based on AI, big data, machine learning and computer vision. “Estrategia Nacional en Inteligencia Artificial”:



Identifies the synergy between the health sector and AI as a strategic field for research. It states that AI will drive strategic projects like simplification of algorithms in healthcare, such as patient triage, and improve the efficiency of the healthcare system.

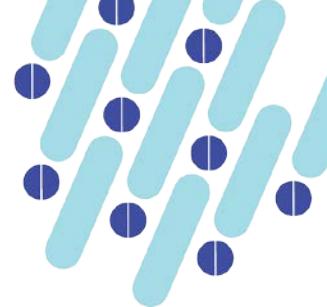
#### d. Medical Studies in Greece

Faculties of Health Science in Greece include the following departments: a) medical, public health, biochemistry and biotechnology, and veterinary medicine. Becoming a Doctor of Medicine (MD) in Greece means following basic medical training consisting of a 364 credits (ECTS). The grade in medicine in Greece consists in a 6-year degree. Each academic year is divided into teaching periods called semesters, the winter and spring semesters. Curriculum courses are divided into twelve independent semesters of study and has a total of 364 ECTS.

Regarding the degree of medicine, students in all Departments of Medicine in Greece must complete 6 years of basic university education. After obtaining their degree, they are obliged to carry out the training program entitled "Rural General Practicioners" lasting 12 months, where the first month concerns training in a hospital and the remaining 11 months of training in a rural health center. After the entire training, the doctors state the medical specialty in which they want to specialize in a specific sector such as cardiology, pediatrics, surgery, etc.. Each specialization program has a different training time and duration.

The medical curricula in Greece have almost no differences compared to other curricula around the world. There is the basic university education which lasts 6 years. After the end of the university education there is the specialization program which lasts from 3-7 years in some specialties such as pediatric surgery, thoracic surgery, neurosurgery and vascular surgery to last 7 years.

The national strategy will set a framework for a holistic policy on the future development and implementation of artificial intelligence in Greece, which will be structured in a set of coordinated and interrelated actions, with the clear aim of maximizing potential benefits and minimizing potential costs, for the economy and society. The national strategy will be a coherent policy text of the country regarding the development of artificial intelligence, which:



- It will determine the conditions for the development of artificial intelligence, including the skills and the trust framework, the data policy and the ethical principles for its safe development and use.
- It will also outline national priorities and areas for maximizing the benefits of artificial intelligence to meet societal challenges and economic growth.
- It will analyze the necessary actions related to the above priorities and will propose horizontal interventions as well as at least one pilot application per policy area.

The implementation of the National Strategy for Artificial Intelligence, through which the mechanisms for planning and implementation of artificial intelligence actions under the new NSRF, concerns the ways of attracting investments and the required interventions for the adoption of Artificial Intelligence (AI) in decided the government. In particular, the Ministry of Digital Governance is proceeding with the announcement of an Open Electronic Tender for the Promotion of a Contractor in the framework of the project "Study of project maturity for the implementation of the National Strategy for Artificial Intelligence"

#### 4. Data analysis

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.



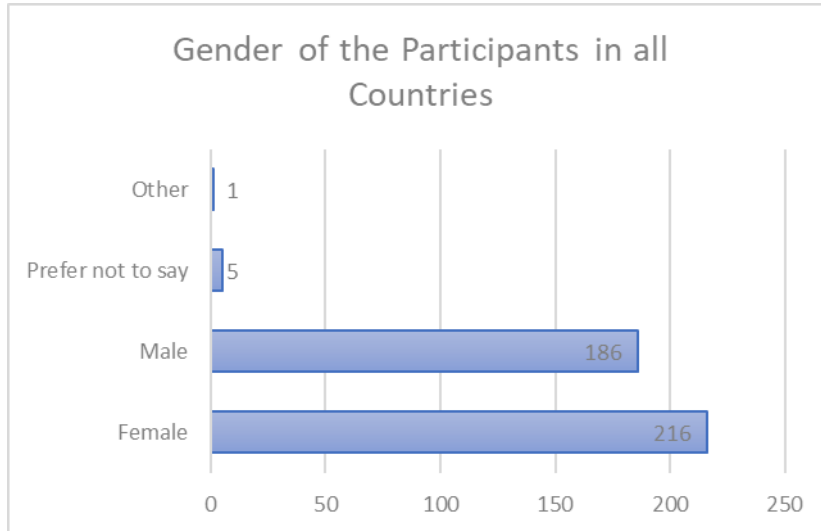
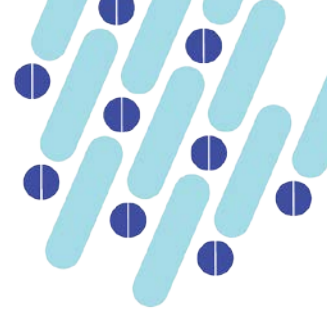


Table 2: Gender of the Participants in all Countries

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. Only 6 professors had experience of less than 5 years and 4 professors of 5 to 10 years, all the rest had professional experience of more than 10 years.

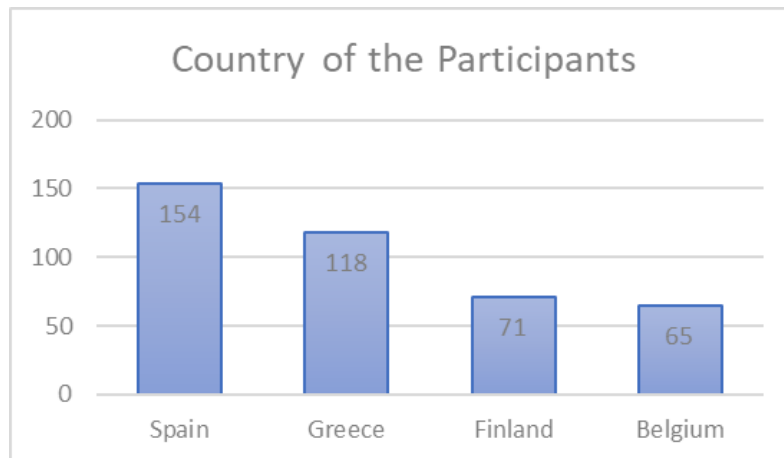


Table 3: Country of the Participants



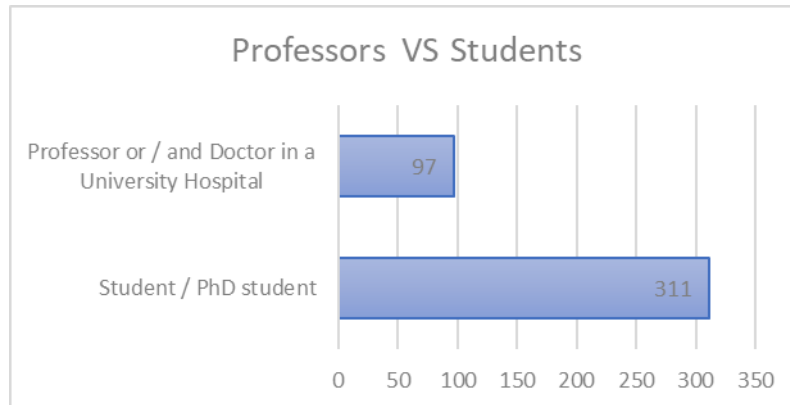
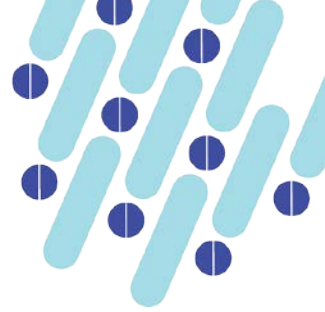


Table 4: Professors VS Students

## a. Professors

### i. AI skills

The graph below concerns the distribution of the understanding of concepts of artificial intelligence, which inclines that **most medical professors do not consider themselves to have a full understanding of the fundamental concepts of artificial intelligence.**

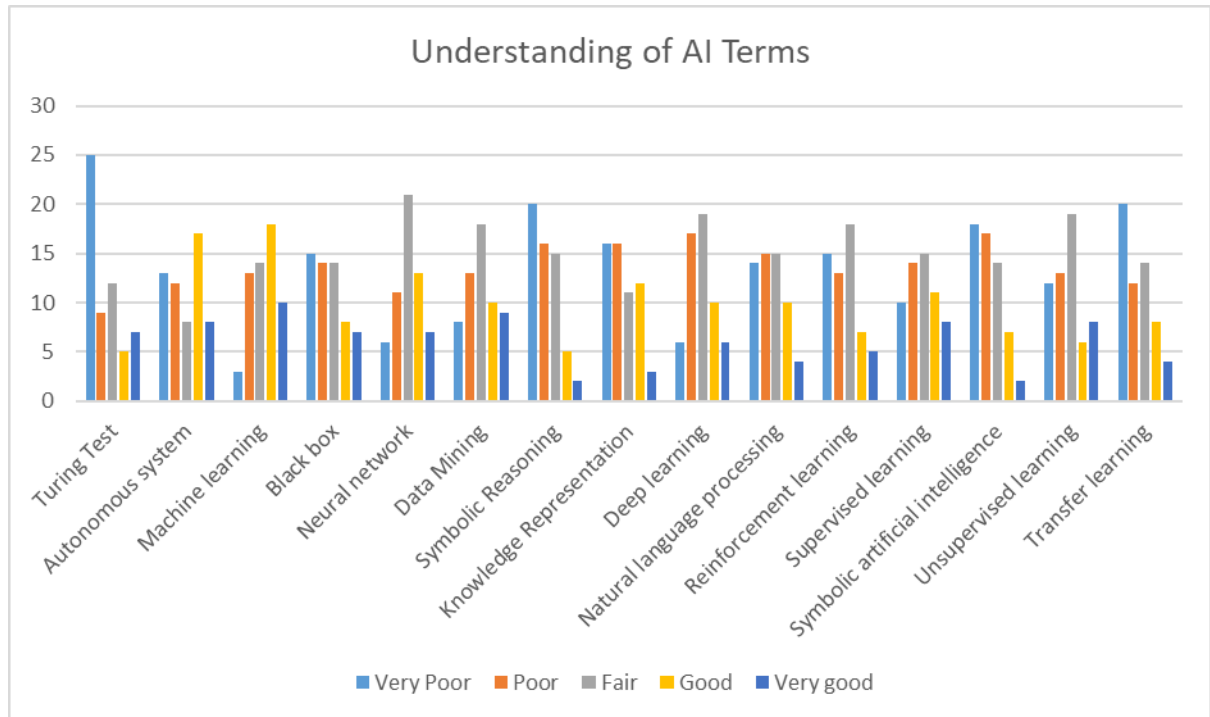
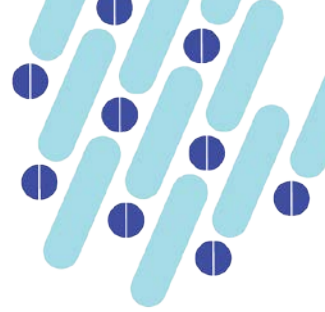
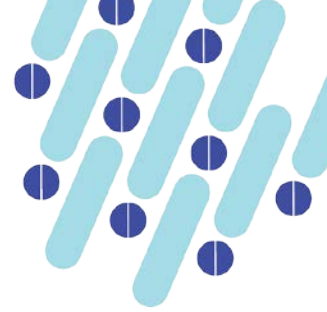


Table 5: Understanding of AI Terms by Professors

The most important finding comes in the question of how to teach and it is clear that **professors prefer distance learning and task-driven self-exploration with peer assistance.**

In addition, **98% of teachers somehow request the introduction of an AI course in the curriculum.**

Finally in the Query of **how many hours are needed, we have a maximum of replies for 2 ECTS**



## ii. Soft skills

In the matter of soft skills, the results are completely different, **90% answer ALL the questions that these skills are either important or very important.**

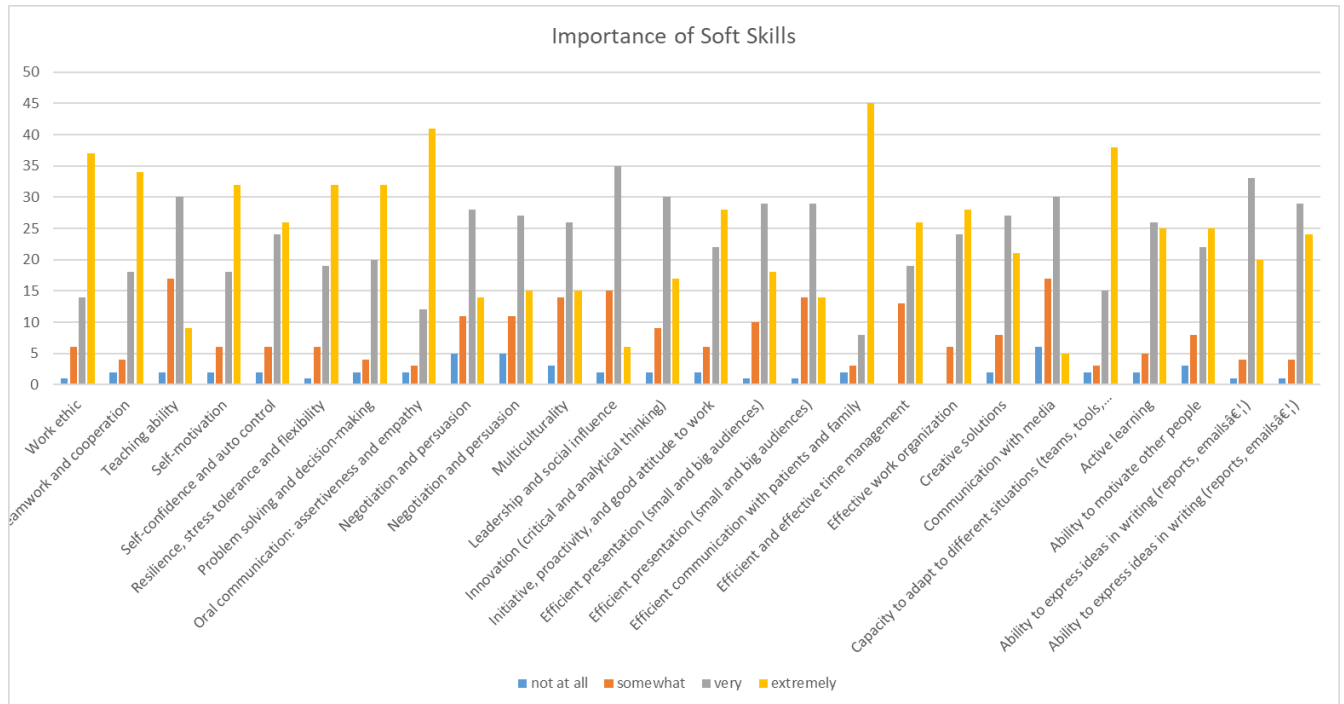
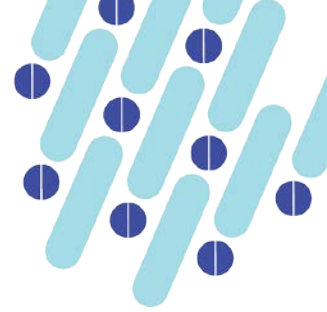


Table 6: Importance of Soft Skills according to Professors

More detailed results for each Soft Skill can be found on the Annex of this Report.

In the question for the way of teaching we have an important difference because, **it is clear that professors prefer distance learning and task-driven self-exploitation with peer assistance; while they avoid presential classes, they opt for a technology-assisted virtual environment.**

**In addition, 40% of the teachers request the introduction of a Soft Skills course in the curriculum as a Mandatory course, while 26% and 31% think that it is better to be included as an optional or continuous learning course, respectively.**



Lately in the matter of hours the distribution is bimodal. **The majority thinks that 1 ECTS is enough.**

b. Students

i. AI skills

Of the students, 146 are undergraduate and postgraduate and 19 are doctoral candidates. The following graph and table show the first significant difference in relation to the teacher population:

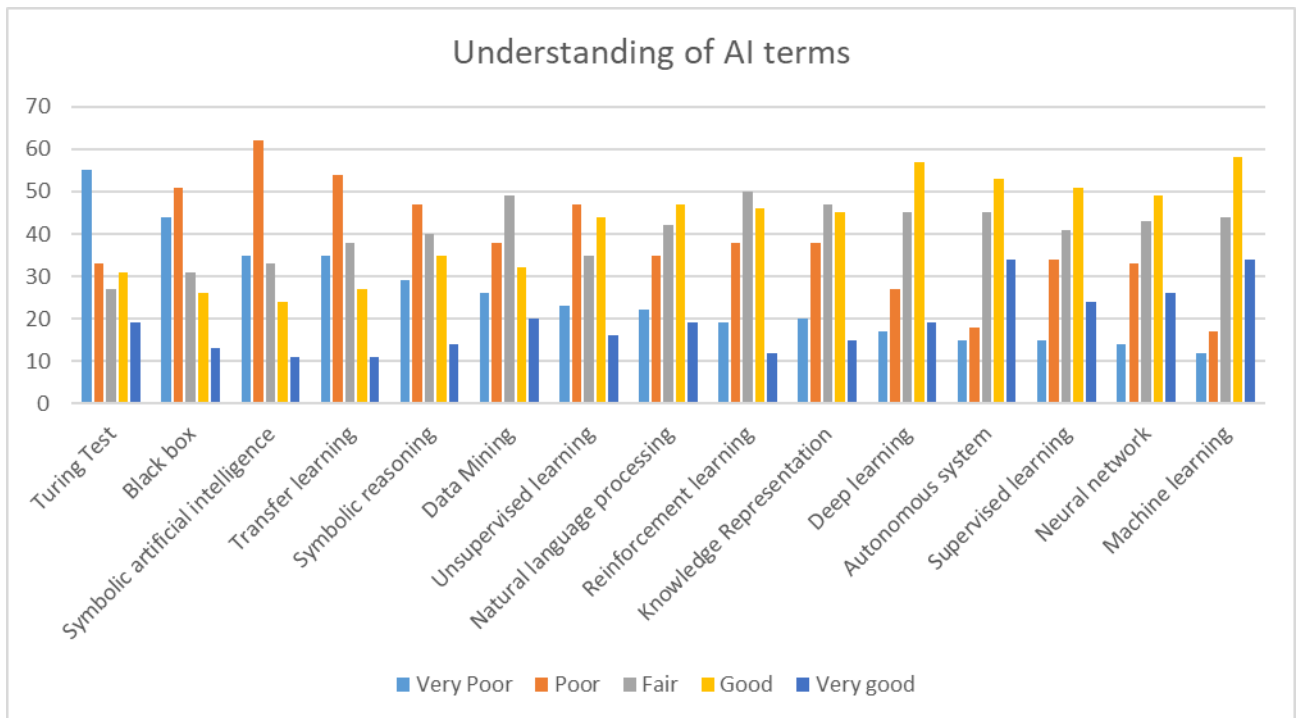
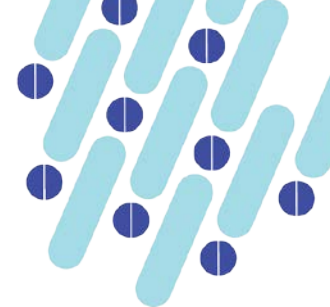


Table 7: Understanding of AI terms by Students



**The students are more confident than teachers in their belief to know about AI, even though, as shown in the literature search below, there are practically no AI course in their curricula.**

In the matter of academic courses the findings are impressive, the distribution is uniform, **there is no clear superiority for any subfield of artificial intelligence.**

When asked at **what level they would like to know AI, the distribution of answers agrees with that of teachers, 38% of high-level comprehension and 44 % of application level comprehension.**

As it is shown from the survey results **it is clear that they prefer distance learning and task-driven self-exploration with peer assistance while avoiding lifelong learning.**

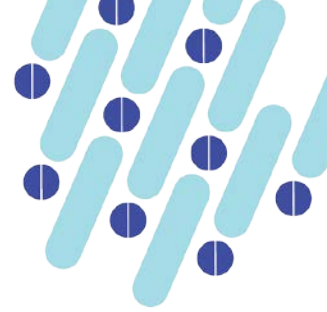
Concerning the type of AI Skills Course the results are form, which indicates that **the majority of them, with 47%, they prefer to be an optional course.**

Lastly about the ideal hours of the AI course **the majority of students (34%) voted for 3 ECTS.**

## ii. Soft skills

In question *"Please rate how important do you consider the training of these competencies (soft skills) for doctors in their profession?"*, the answers follow a distribution with a right slant, **they consider all the characteristics related to soft skills very and extremely important.** (The full results with votes per Soft Skill can be found in the Annex of this Report).

In the matter of soft skills **the results are completely similar to the professors**, but in the answer for **the way of teaching we have a significant difference because it is clear that they prefer distance learning and task-driven self-exploration with peer assistance while avoiding the face-to-face lesson and the technology-assisted virtual environment.**



In addition, the 39% of the students request the introduction of a skills course in the curriculum in a mandatory way, while 37% and the 24% preferred the Continuous Learning or Optional way of admission as shown in the graph below.

And here in the matter of hours the distribution is two-peak, the majority of them (33%) prefer a 81 hours course while we have also a strong vote for 54 hours course with 21%

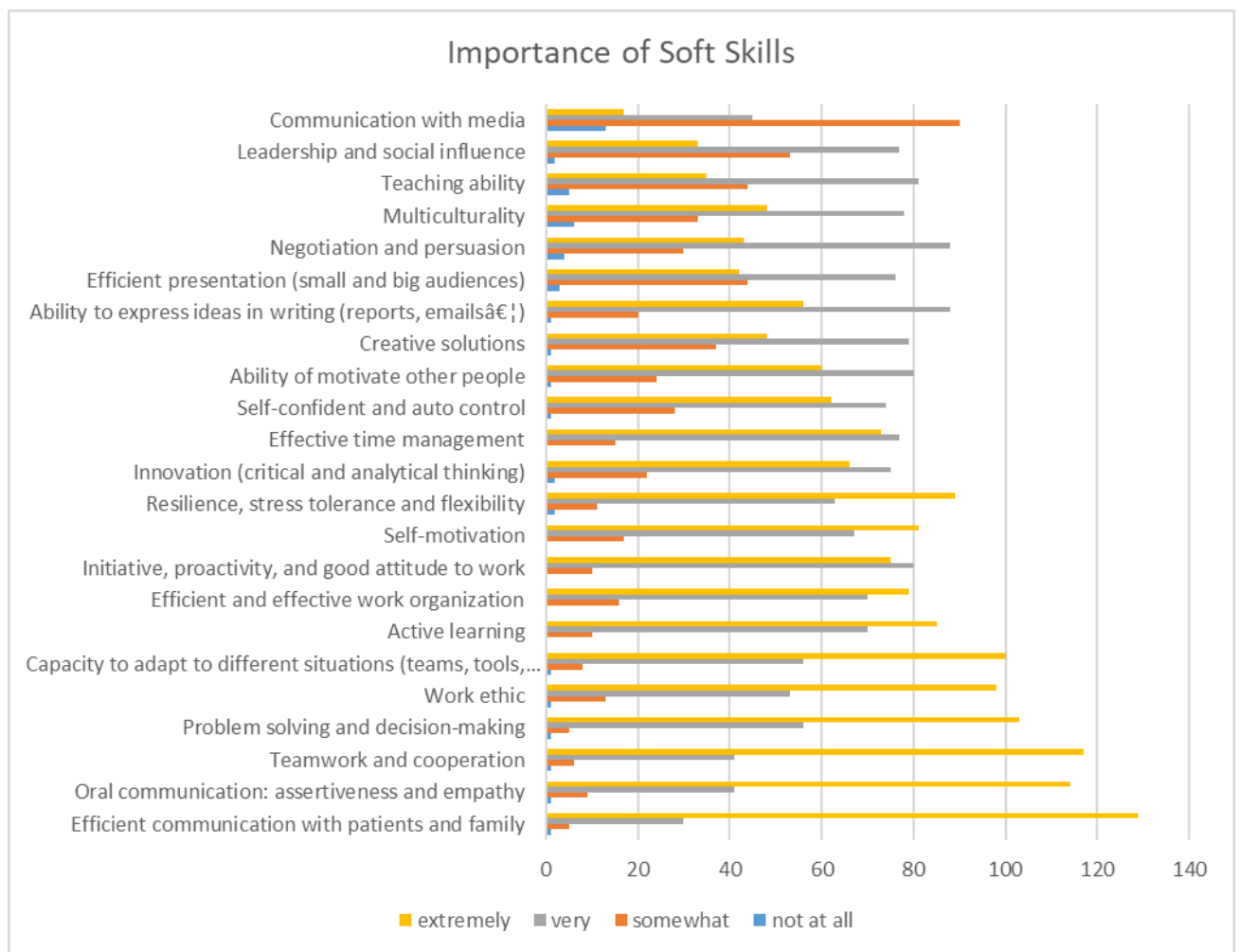
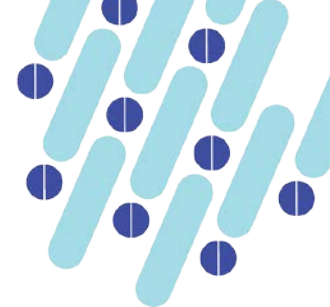


Table 8: Importance of Soft Skills according to Students



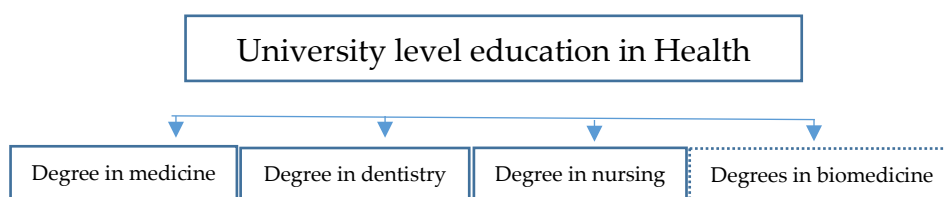
## 5. Desk research by Country

### a. Desk research of Finland

#### i. National curricula in Finland

##### 1. Structure

### The structure of the Medical Schools in Finland

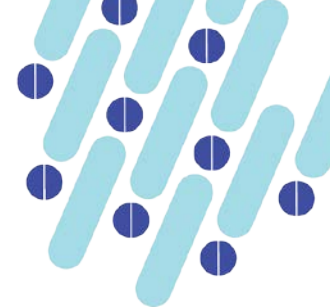


*In this report, we have focused on the university level education of the degrees in medicine, dentistry and nursing sciences, i.e. to professions working with patients. However, we will present a number of courses on AI and soft skills, which are provided by the discipline of biomedicine in the different Finnish Universities, and which can be taken as elective (optional) studies also within the degrees' studies of medicine, dentistry and nursing sciences.*

*Specifically, the degree in medicine can be studied in the Universities of Turku, Tampere, Helsinki, Oulu and Eastern Finland, the degree in dentistry in the Universities of Turku, Helsinki, Oulu and Eastern Finland, and the degree in nursing sciences in the Universities of Turku, Tampere, Oulu, Eastern Finland, and Åbo Akademi University.*

### The structure of curricula

*In **Medicine** or **Dentistry**, the degree in Finland consists of 12 or 11 semesters, respectively. This means 6 or 5,5 years of full-time studying. The curriculum consists of preclinical (2-3 years) and clinical studies in the Universities of Turku, Helsinki, Oulu and Eastern Finland. Tampere University applies a problem-based learning pedagogy and, thus, preclinical and clinical studies are taught together. In all the Finnish Universities the curriculum of medicine consists of 360 ECTS and dentistry of*



*330 ECTS, similarly to other European Universities. Most of the studies are fixed and harmonized across the medical faculties, based on the core learning objectives. However, there are a few ECTS for optional (elective) studies included (about 10-30 ECTS, depending on the university)*

*In **Nursing Science** there are two degrees available: Bachelor's degree in Health Sciences and Master's degree in Health Sciences. Students are generally required to have a nationally recognized first cycle degree: normally a Bachelor's degree from an accredited institution of higher education from relevant field. A Bachelor's Degree in Health Sciences consists of 2 semesters, which means one year of full-time studying. The curriculum for Bachelor in Health Sciences contains 180 ECTS, out of which 120 ECTS is credited from prior education – that is the required first cycle degree (Bachelor's degree).*

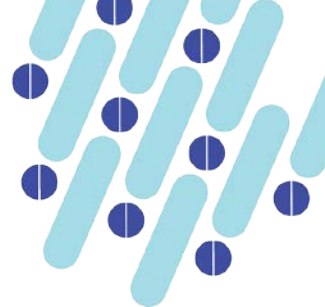
*The Master's degree in Health Sciences consists of 4 semesters, which means two years of full-time studying. The curriculum for Master in Health Sciences contains 120 ECTS. Studies are offered mainly in Finnish language but in most universities, some courses are offered in English as well. Students can choose to specialize in nursing leadership and management with expertise in several clinical areas or in health education and the didactics of nursing science (teacher training). The offered programs and the options for specializing vary by different universities. The contents of the curricula for Bachelor in Health Sciences and Master in Health Sciences are different, depending on the university. However, the degrees are similar in structure and law regulates core-learning objectives. Additionally, UTU, in collaboration with the Fudan University, Shanghai, China, provides an International Double Master's Degree Program in Future Health & Technology (120 ECTS) which is provided fully in English (application requirement Bachelor's Degree in Health Sciences).*

## *2. Courses in Finland*

### *a. Courses of AI*

In the Medical Faculties of Finnish Universities there are a few courses in which Artificial Intelligence (AI) and various medical AI-applications used in medical practise are being taught.





**1. How AI can support Health Science, AI Academy, Degree in Nursing, University of Turku**

*The course will provide the student an understanding on (1) how health data accumulates during an individual's lifespan, (2) how these data are stored in the national and local medical record, and (3) how these data can be used for different analyses in order to increase the overall health at the population and individual level. ([link](#))*

**2. AI in diagnostics, drug discovery & development, and bioimaging (Degree in Biomedicine), AI Academy, University of Turku**

*The course teaches AI applications for processing of genome data and medical imaging data, both of which contribute to and are utilized by the biobanks and digital pathology. In addition, during this course, students will learn how AI is used to instruct the mining of large sets of medical data for the development of medical instrumentation. Finally, students will learn how AI helps to model the interactions between a drug molecule and its target molecules, reveal new interactions/innovate new putative drug molecules and, consequently, predict how a drug candidate will behave in the human body. ([link](#))*

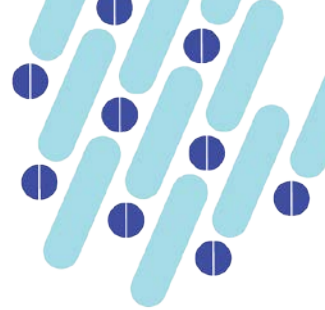
**3. Health Technology - When a Physician and an Engineer meet, Degree in Medicine and Dentistry, University of Turku**

*A joint course for medicine and engineering degree students where they build multidisciplinary teams to share and combine their knowhow for the benefit of a joint goal, which is to explore, showcase and explain a health technology innovation to other teams/course participants and their teachers. The course includes visits to a company/hospital/health technology developer or provider, chosen by the team. ([link](#))*

**4. Health Care Processes and Information Systems, Degree in Biomedicine, University of Tampere**

*The purpose of the course is to give students a general understanding of applying ICT technologies in the area of health care, with the focus on the special needs placed for information management in this area.*

*The course aims to:*



1. *provide students first a basic understanding of health care processes and health care systems: how they are managed, organized and funded in Finland and in other countries*
2. *present the specifics of health information, how it is utilized in health information systems, what are the key standards and how they are utilized in building health information systems*

*The course is intended especially for those students who are planning to work in the health care domain, either in research and development or in managerial roles. ([link](#))*

#### **5. *Big Data and AI in Clinical Medicine, Degree in medicine, University of Helsinki***

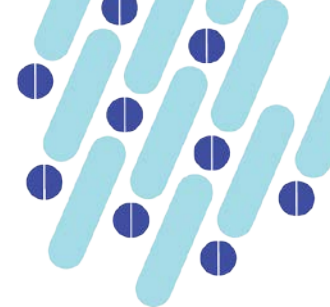
*AI and the data (so called “big data”), collected through various methods and technologies, will strongly effect and change the way health care and medical professions will be performed in the near future. The aim of this course is to address these challenges. ([link](#))*

#### **6. *Basics in eHealth, Degree in Medicine and other Health Sciences, University of Oulu***

*The course will cover the following topics ([link](#)):*

- *Terms and concepts*
- *Societal dimensions*
- *Delivery of health services*
- *Electronic patient records*
- *Data transfer within the health care system*
- *Data transfer between the health care professionals and the citizens*
- *Citizens providing their own health data, mHealth-solutions*
- *National healthcare information exchange in Finland*
- *Remote consultations, examples like teleradiology, telepsychiatry, telerehabilitation*
- *Economical and functional assessment*
- *Remote education in health care*
- *Future visions of health care information systems*

*In addition: changing topics related to health sciences according to availability, such*



as:

- *Artificial Intelligence,*
- *Knowledge based medicine,*
- *Cybersecurity*

#### b. Courses of Soft Skills

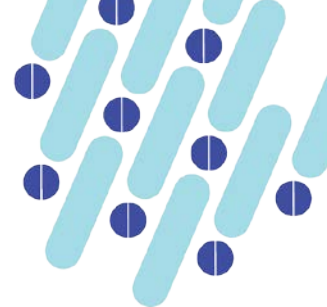
The courses described below are those in which the *focus* is on soft skills and which are currently being taught by different Medical Faculties in Finland. It is important to acknowledge, however, that in the curricula of the Medical Faculties soft skills contents are embedded into several other courses as well, where the main focus of the course can be on a wide range of other topics/medical specialities. We only chose courses where soft skills are specifically mentioned in the course description and/or learning outcomes. These courses, which are also depicted in the Figure 1, below, are being taught in six Finnish universities in the disciplines of Medicine, Dentistry and Health Sciences /Nursing Science.

To obtain this list, we first screened and selected manually the study guides (containing all the courses listed in the curricula) of the above mentioned disciplines and faculties. Secondly, the study guides were screened using a computer programmed code to identify the study modules, and to find their corresponding web pages. A second computer assisted search was performed to find out the study codes/course abbreviations of the various courses, the names of the courses and their learning outcomes. Lastly, the search also indicated whether any pre-defined key words referring to soft skills were mentioned in the names and/or learning outcomes of the courses.

##### ***1. Personal Growth and Career Planning (T5-T6), Degree program in Bioscience, University of Turku, ([link](#))***

*In the career development seminars different bio/medicine career choices and international opportunities will be introduced to the students, as well as a number of national companies and other employers within the field of bio/medicine.*

*In addition, alumni will participate in the seminars and introduce their field of work, career paths and work experience. The topics introduced and discussed may vary in different years.*



*In the spring semester the students participate in thesis and project work seminars in order to enhance their own scientific thinking*

**2. *Team Communication and Leadership, Degree programme in Medicine, University of Turku, ([link](#))***

*The students familiarize themselves with the principles of interaction and group communication phenomena, and functioning as a team leader and the tasks it requires. They get a view and an understanding of the interactions and relationships of a multidisciplinary team, as well as how to be a dialogical and good listener. The students will get an idea and understanding of their own interaction skills, practice team communication, and analyze and specify team interactions.*

**3. *Digital Management and Leadership in Health Care, Master of Health Sciences, University of Turku, ([link](#))***

*The course will cover the following topics:*

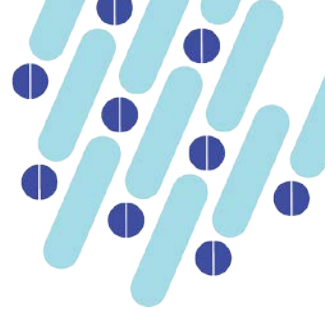
- *Knowledge management and health technology in leadership*
- *Health care data architecture*
- *Data collection, management and usage*
- *Big Data, data and text mining*
- *Digital health services*
- *Health care information systems*
- *Data security*

**4. *Design Thinking in Healthcare Innovation, Master of Health Sciences, University of Turku, ([link](#))***

*The course concentrates on Design Thinking (DT) process and its application in health care innovation process. It will cover the following topics:*

- *solving of real-life clinical problems during the course*
- *using of the six-phased DT process, from empathizing to testing in multidisciplinary groups*

*The course is suitable for master and doctoral level students of Health and Life Sciences, who are interested in learning about the possibilities of solving clinical problems in health care within a group using a Design Thinking approach.*



**5. Intercultural competence and professionalism, Health Sciences, University of Eastern Finland, ([link](#))**

Concepts related to inter-culturalism, multiculturalism, professional development, critical incidence technique.

**6. Health Technology and Life Science Business, Master's Programme in Biomedical Technology, Tampere University, ([link](#))**

The course will cover the following topics:

- Introduction of health tech and life science industries
- Business economics and business models
- Legal aspects of partnering and finance
- Entrepreneurial mindset and business thinking
- Design thinking in Business
- Go to market approaches
- Entrepreneurial finance
- Market analysis / How to structure a VC pitch
- How to establish a company

**7. In the News: Viewpoints and Values Represented in International Media, Bachelor's Programme in Health Sciences, Tampere University**

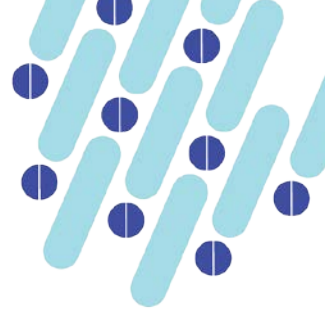
The course will cover the following topics ([link](#)):

- Societal, political or economic news items
- Media literacy & text types
- Values represented in the media
- Media bias

**8. Entering the Global Workplace: Interculturality and Communication, Bachelor's Programme in Health Sciences, Tampere University**

The course will cover the following topics ([link](#)):

- Culture vs organizational culture



- *Internationalization of the workplace at home and abroad*
- *Globalization, localization and glocalization*
- *Languages in the workplace: key or lock?*
- *Communication and negotiating conflict*

**9. *Biodesign innovation, Degree Programme in Medicine, University of Helsinki***

*The course will cover the Biodesign process, consisting of ([link](#)):*

- *needs identification*
- *concept creation*
- *customer-centric design*
- *intellectual property basics*
- *regulatory process of medical technology*

**10. *Let's lean – Lean and healthcare operations management, Degree Programme in Medicine, University of Helsinki ([link](#))***

***Part I***

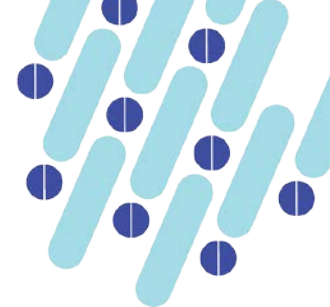
*Methods of industrial engineering and management in operation leadership and development 2,5 ECTS*

*(Course literature: Vissers&Beech Health Operations Management, Lillrank Logics of Healthcare)*

- 1. Leadership and development methods (Lean, TOC, VBHC, SOM)*
- 2. Leading the service episodes and departments*
- 3. Describing and modeling of operations; quantitative methods*
- 4. The different levels of functioning in leadership and development: the operative, tactical, and strategic levels*

***Part II: Lean (the concept of lean), 2,5 ECTS:***

- 5. Deepening the general overview (standardizing work; systematic and continuous development of standardized work; Lean) and independent studying of literature: “This is Lean”*



6. *Lean as a leadership model*
7. *5S Organizing and visualizing a workplace /case studies & narrative*
8. *Standardization and development of work and care in leading the daily work – theories and stories*
9. *The day in a hospital: Practical work / observing or interviewing: 'shadowing a patient'(patient/nurse/physician/other)*
10. *Practical work*

#### ii. Vocational Education Training in Finland

Universities in Finland offer 50 specialist training programmes in Medicine and 5 programmes in Dentistry. The number and titles of specialities have been defined in Finnish legislation on specialist education (Decree No 56/2015).

Specialist training in medicine/dentistry can be taken by professionals licensed by the National Supervisory Authority for Welfare and Health (Valvira) of Finland. The specialist degree requires usually 5 or 6 years of medical practice including at least 9 months of services in public health care centers, theoretical and administrative courses and passing a national written exam.

In Finland Universities do not provide any specific curricula or courses. While the Faculty grants the study right, the training itself takes place within the health care system.

The selection of physicians to the training posts at Faculty-approved training units is conducted as per the respective selection procedures of the organisations in question.

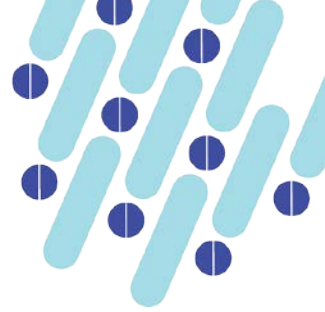
#### iii. Policy making policies in Finland

##### **3.1 National Health AI/soft skills Strategy**

The previous government (2015 – 2019) of Finland made artificial intelligence (AI) as one of its key projects. The Minister of Economic Affairs launched the Artificial Intelligence Programme in May 2017. Later in the same year, the first eight key actions were presented for making Finland one of the leaders in the application of AI. This work was later supplemented with separate analyses and recommendations for measures on the future of work, ethics and security. (1) It should be mentioned that the governmental funding programs steer strategic decisions, as discussed below in 3.3.

##### **3.2 Policy Principles for AI/soft skills in Health**





Finland's stability and security combined with high technology utilization rate and education level provide an excellent platform for the creation and development of digital business. The development of data policy and data management in a way that takes the different life situations of citizens into account is a unique innovation by global standards.

### **3.3 Strategy in national funding for AI**

In Finland, the government has two long-standing major funding agencies, 'Academy of Finland' and 'Business Finland' which also fund -and thereby steer strategies of- AI research and AI application development. Business Finland's AI Business program accelerates the global growth of the Finnish digital service business. AI and platform economy can automatize currently localization-dependent operations and services. Most recently, the current Government (started in December 2019) announced the National Artificial Intelligence Programme AuroraAI based on its strategic objectives for building a dynamic and thriving Finland. The program will create an AuroraAI network, which will be available for citizens and organizations by the end of 2022 to. These funding instruments enable Finland also to provide significant international services.

In addition to the government there are many private funding institutions contributing to funding of scientific research including AI research and development.

## **b. Desk Research of Belgium**

### **i. National Curricula in Belgium**

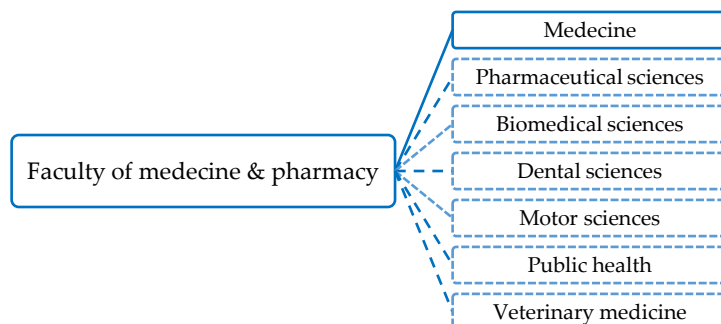
#### *1. Structure*

The existing situation in national level: it refers to official degree and postgraduate degree (official master's degree and postgraduate studies)

#### **The structure of the Medical Schools in Belgium**

*In Belgium we have this structure:*





*Faculties of medicine and pharmacy include medicine (clinical sciences), pharmaceutical sciences, dental sciences, biomedical sciences, veterinary medicine, motor sciences and public health.*

*Becoming a Doctor of Medicine (MD) in Belgium means following basic medical training consisting of a 180 credits bachelor's and a 180 credits master's degree. According to the Belgian medical legal system, additional residency training in combination with an advanced master's education (general practice/family medicine, specialty medicine, etc.) is compulsory to become active as a professional physician who can and may practice medicine at his or her own responsibility within the Belgian legal and social security framework.*

### **The structure of curricula**

*The education to become a professionally active physician is phased through three cycles with an increasing degree of acquired competences:*

*1. Bachelor's degree*

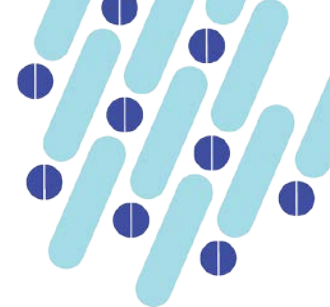
*180 ECTS, equivalent to three years.*

*It includes the basis and introduction in Medical Science, Health Statistics, and other intermediate disciplines useful for Medicine (physics, biology, chemistry, biochemistry, immunology, embryology, physiology, microbiology, immunology and some basic pathology and clinical skills).*

*2. Master's degree*

*180 ECTS, equivalent to three years*

*The master's degree offers training in a diagnostic and therapeutic approach modeled on clinical practice, organized within sectors, which integrate the different*



specialties, to cover all aspects of the management of a pathology, from history to treatment. It includes;

- extensive clinical education in all areas of medicine;
- a large number of internships in the various hospital services

The bachelor's degree + master's degree led to the MD degree, the starting point for the advanced master's degree to become a practicing physician.

ECTS stands for European Credit Transfer and Accumulation System.

### 3. Advanced master's degree

The advanced program consists of 120 to 180 ECTS credits as well as a professional medical residency training lasting three to six years depending on the medical specialty.

It is possible to pursue doctoral training to obtain a PhD-degree after obtaining a master's degree. Doctoral training can occur during or after the advanced master's degree in specialty medicine.

## 2. Courses

### 1. **Basics of IT in the health sector (UCLouvain; optional course) [link](#)**

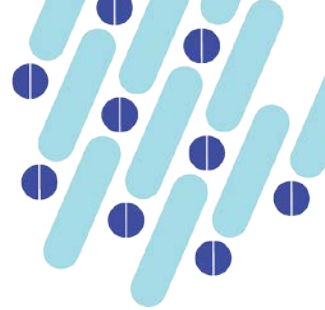
The course deals with the study and organization of the information system in the field of health from the perspective of a multidisciplinary communicating system in support of health care. The information system is approached, on one hand, as one of the components of the health system and, on the other hand, as a tool for the practitioner.

### 2. **Statistical reminders and clinical studies - preparation for MA thesis - medical informatics (ULB; compulsory course) [link](#)**

The primary objective of this course is to provide the student with logical and technical tools allowing to carry out his MA thesis. Beyond this utilitarian aspect, this course also provides the student with the opportunity to develop his aptitude, reasoning and communication.

At the end of the unit, the student will be able to:

- Ask a precise research question
- Evaluate which statistical methods should be applied
- Compile a file for the ethics committee



- To have an analysis of how medical reasoning works
- Be aware of the new General Data Protection Regulation (GDPR)
- Understand the new paradigms of tomorrow's medicine in a digital world

### **3. Artificial Intelligence for everyone (KULeven; optional course) [link](#)**

The course offers an introduction to AI at a university level, specifically aimed at the non-technical student. It introduces the necessary basic concepts, principles and techniques that allow to understand AI applications. This way the student will better understand the potential, but also the limitations, of AI. So, he gets a clearer picture of what AI can and cannot do. This also allows him to discover opportunities to apply AI in your own domain.

In addition, the course offers an ethical framework that allows for a critical look at existing and new AI evolutions. This will equip him to enter a discussion about AI and the ethical and societal consequences that the application of AI entails.

### **4. Integration 1,2 & 3 (Antwerpen university, Compulsory courses) [link](#)**

Students are taught to make connections and to broadly open their own thinking process to different perspectives. On the basis of the teaching methods used, attention will also be paid to the development of various generic competences, such as working in a group, looking up information and presenting.

### **5. Media and digital society (Antwerpen university, optional course) [link](#)**

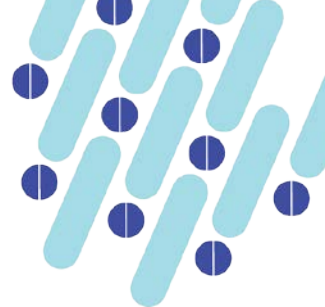
The basic aim of the course is to make students aware of the mechanisms of the media in the digitized society and the risks of distorted opinion formation and polarization. By making students familiar with these mechanisms, they are better prepared to see the opportunities and risks in their own domain for the dissemination and application of (scientific) knowledge and information, as well as the development of ICT applications. The course is built up by approaching the subject from different angles.

## ii. Vocational Education Training (VET) in Belgium

### 1. Structure

#### **The structure of the Medical VET programs lifelong learning**

The doctor has the obligation to follow continuous training. The terms and conditions of this continuing education are set by the Minister on the proposal of the National Medico-Mutual Commission. This continuing education implies at least the obligation to obtain 20 credit points (CP) including 3 CP in the "ethics and economy" section and



*2 participations to the meetings of the local medical quality assessment group (GLEM) to which the doctor is registered.*

*The Faculties of Medicine organize a series of complementary training courses in the form of a certificate for professionals. Access conditions are specified for each training. More than twenty continuing education cycles are offered at the school of medicine, very often in collaboration with other universities or other training institutions.*

*A policy of self-training is also encouraged (medical journals, webinars, etc.) and the participation to national and international meetings can also be credited.*

### **The structure of curricula**

*The proposed courses categorize under:*

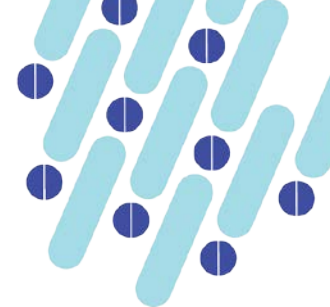
- *Short courses*
- *Advanced cycle in hospital sciences*
- *University or inter-university certificates*

*The major topics of formation*

- *Health economics*
- *Health system*
- *Health management*
- *Medicine (sports and / or professional context, hospital hygiene and environmental medicine)*
- *Society*
- *Certificates required by Belgian law for professional practice (University Certificate in Physical and Biological Radiation Protection and University Certificate in School Medicine)*
- *Public health*

*Some webinars are organized for the presentation of AI generalities to non-specialists.*

*Training initiatives are organized in specialties specifically concerned with AI: radiology, dermatology, ophthalmology and anatomopathology (image analysis); neurology, cardiology (analysis of EEG, ECG) [Link 1](#), [Link 2](#), [Link 3](#)*



## 2. Courses

### 1. **Design and Management of the Strategy of Healthcare Institutions (UCL-ULB) [link](#)**

*This certificate aims to provide, well beyond strategic tools, real strategic know-how and interpersonal skills for anyone with institutional responsibilities at any level in a repositioning project in this context [link](#). The program is intended for graduates of long-type higher education.*

### 2. **Multidisciplinary management of exceptional situations [link](#)**

*This teaching extends from the basics of disaster medicine to notions of the overall management of a collective emergency event. It becomes essential for professionals to train and update their knowledge and skills, necessary for the management of terrorist attacks, rail disasters or other major accidents ... The management of exceptional situations is becoming more and more important in our current society.*

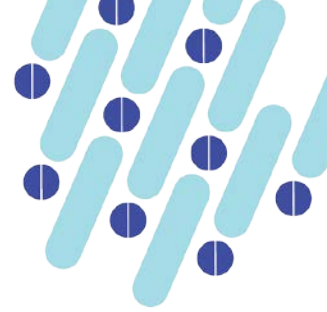
### iii. Policy Making Policies in Belgium

*Belgium is a complicated country, and the Belgian AI strategy presents policy actions at federal and regional levels, distinguishing between measures for the Federal State, Flanders, the Walloon region, Brussels Capital, and those of the Wallonia-Brussels Federation.*

*The Federal Government launched AI4Belgium the Belgian coalition for AI. Among them, a specific AI4Health working group aims to promote the implementation of AI in healthcare and AI education in medicine. The AI4Belgium coalition recommends developing a responsible data strategy where trust is the cornerstone of any transformation, while a robust and up-to-date legal framework, ethical principles and more transparency are needed. Building a data ecosystem that facilitates more responsible data-sharing with reinforced open data policies, more collaborations and a platform with well-structured tools and approaches is one of their objectives.*

*Also, the Secretary of State for Digitalization has launched "Digital Minds" to tackle the broader digital sense. Among these Digital Minds, health is included in government competences in specialized "Councils" (each council represents a pillar - government, industry, etc.). Digital Minds and AI4Belgium work very closely together.*

*The regions, for their part, operate in various fields:*



*In the Walloon region the DigitalWallonia4.ai program has the objective of accelerating the adoption of AI in the region. The overall budget, which also includes industry 4.0 and the regional digital strategy "Digital Wallonia", is 18 million EUR per year. Since December 2020, the regional AI program includes a research project called "ARIAC by DigitalWallonia4.ai" launched in the framework of the TRAIL consortium, which brings together universities and research centers in the Wallonia-Brussels Federation. The 32 million EUR project is funded by the Walloon Region and runs from 2021 to 2026.*

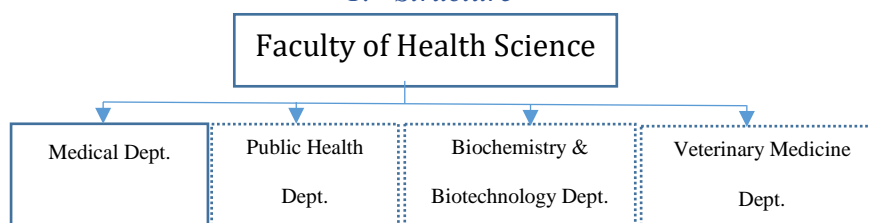
*The Flemish Government launched the Flemish action plan to foster AI in Flanders. The Flemish AI action plan foresees an annual budget of EUR 32 million for its implementation, broken down as follows: EUR 15 million dedicated to the implementation of AI within companies, EUR 12 million allocated to basic research, and EUR 5 million to supporting measures (training, ethical and legal aspects related to AI-adoption, and outreach activities). This funding is complemented with other policy instruments of both FWO (funding for HEIs) and VLAIO (funding for enterprises). In 2020 FWO invested about EUR 15 million and VLAIO some EUR 45 million in AI related projects. The same amounts are expected for the following years. The Flemish AI policy plan also draws particular attention to the development of AI for the healthcare sector. In line with the Flemish policy plan for 2019-2024 and the framework of Flanders Care, a specific focus is given to support new cooperation models between the public health care sector and the industry. Agoria has recently launched an AI-MOOC for the health sector.*

*For the Brussels-Capital Region, the innovation funding body Innoviris has been playing a major role in the support of AI-related research and innovation efforts in Brussels. All these regional initiatives are joined up at the level of AI4Belgium.*

### c. Desk Research of Greece

#### i. National Curricula in Greece

##### 1. Structure







Faculties of Health Science include the following departments: a) medical, public health, biochemistry and biotechnology, and veterinary medicine. Becoming a Doctor of Medicine (MD) in Greece means following basic medical training consisting of a 364 credits (ECTS).

The grade in medicine in Greece consists in a 6-year degree. Each academic year is divided into teaching periods called semesters, the winter and spring semesters. Curriculum courses are divided into

twelve independent semesters of study and has a total of 364 ECTS.

The national curriculum ([link](#)) consists in a list of core subjects with their respective ECTS.

In the Medical Department there are 8 sectors (morphology, basic sciences, clinical laboratory, pathology, surgery, mother and child, neurology and sensory organs and social medical sciences) as well as 27 clinics and 24 laboratories which are distributed in all sectors.

## 2. Courses

### 1. **Medical Statistics**

The course deals with the study of descriptive medical statistics, sampling, the concept of statistical test - zero hypothesis - statistical errors, possible error and mean values of reliability - comparison of mean values ( $t$  test) - statistical test  $\chi^2$ , possible error ratio and reliability limits, basic probability rules, correlation and simple linear dependence (regression) of quantitative characteristics, multiple linear dependence and other statistical models, interpretation of statistical findings, non-parametric statistical tests, evaluation of laboratory findings.

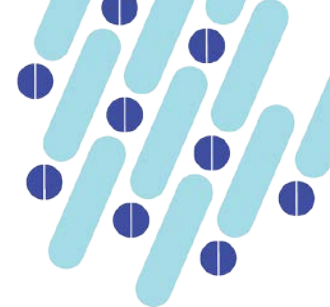
### 2. **Bioinformatics with applications in Medicine**

The course includes students' practical training in specific scenarios for the use of bioinformatics tools and databases.

## ii. Vocational Education Training in Greece

### 1. Structure

The Universities of Athens and Crete, through their lifelong learning programs, offer educational programs in health professions in order to specialize in specific topics of Medical Science.



*These programs have a specific course structure, with approximately 3 to 8.4 ECTS, lasting a few months.*

*The Draft Law "National System of Vocational Education, Training and Lifelong Learning and other provisions" foresees for service providers, in the context of non-formal learning provided to adults:*

- a) continuing vocational training,*
- b) reskilling,*
- c) upskilling;*
- d) general adult education; and*
- e) counseling and career guidance.*

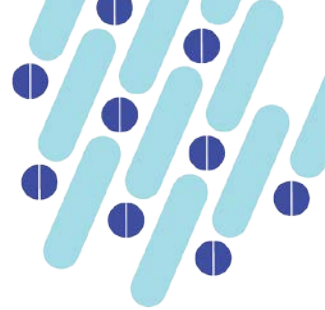
*The trainees may belong to the public or private sector.*

*The Continuing Vocational Training and General Adult Education programs, provided by VET (Vocational Education Training), have a theoretical or laboratory part or both, or an internship, where provided in the foreseen program. The total duration of the training program is determined based on its subject matter, the purpose of the intervention and the profile of the participants, in accordance with the specific definitions in the respective invitations / announcements of the project beneficiaries. Regarding the number of participants in learning classes cannot exceed twenty five (25) people or fifteen (15) in cases of programs aimed exclusively at special social groups, such as the disabled. The criteria for the inclusion of the participants in the learning sections are determined in the respective programs.*

*After the end of a successful attendance of a certified program of VET, a certificate of attendance is issued, which are signed by the Director of Training of VET, bear the distinctive title, the logo of VET and its licensing code and indicate the exact title, duration in hours, dates and location of the program. For the successful attendance of a certified program of VET, the following conditions must be met:*

- a) Confirmed participation, live or remote, of the participant in the programs;*
- b) evaluation of learning outcomes and*
- c) successful completion of the internship, where required.*





## 2. Courses

### **1. Biomedicine and Engineering Science Applications. University of Athens**

*The purpose of the program is to familiarize the trainees with a number of applications of Engineering Science in Biomedicine, which include medical imaging, recording of physiological parameters, medical data and artificial intelligence, biomaterials and robotics, as well as the systematization of knowledge.*

*By presenting basic concepts of mathematics, computational thinking, physics, engineering and electronics, in direct contrast and correspondence with the above biomedical applications, an in-depth understanding of advanced technological applications in Biomedicine is achieved.*

*At the same time, specific and applicable techniques for the analysis of medical signals and medical images, which are useful in clinical diagnosis, will be taught. The study of biomedical applications of Engineering Science will enable learners to identify and articulate complex issues of biomedical research and practice, and to develop innovative interdisciplinary approaches to solving them.*

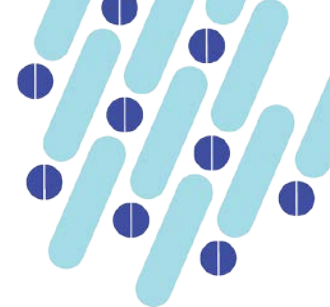
### **2. Medical Ethics and Bioethics, University of Athens**

*This program presents the basic directions of modern Medical Ethics, as a branch of Bioethics, focusing on the regulatory issues encountered in a wide range of medical practices. In the context of this presentation, reference is also made to the applicable law but without limiting ethical reflection and debate alternatives.*

### **3. Medical Psychology, University of Athens**

*The Educational Course "Medical Psychology" was developed in order to examine issues of mental health and illness, through the prism of the field of Psychiatry, as well as training in the evaluation, diagnosis and treatment planning of relevant cases, in a holistic and specialized way. to the special care requirements of patients with physical or mental disorders.*

### **4. Clinical Medical Practice - Emergency Clinical Cases, University of Athens**



*The main purpose of the Program is to develop skills and clinical applications in clinical medicine for all health professionals, based on basic knowledge Pathology, Surgical Pathology, Traumatology as well as Neurophysiology and Functional Neuroanatomy.*

#### **5. Telemedicine and Health services, University of Athens**

*This program does not aim at a simple description of its theoretical framework Telemedicine. The aim is to overcome the barrier of theory and to introduce the learner to the essence of Telemedicine, i.e. to the applied services, while giving the basic elements on the organizational impact of the services.*

#### **6. Child and Adolescent Psychiatry, University of Athens**

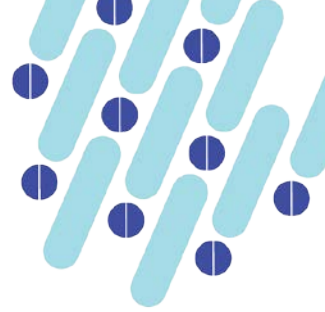
*A course on scientific dissemination with the objective of bringing the science to society.*

#### **7. Biostatistics, University of Crete**

*The aim of the course is to gain sufficient knowledge of the fundamental statistical concepts and techniques that are widely used in medical research. The course emphasizes the development of statistical thinking and the correct interpretation of the results of research studies. The lectures aim to get to know and understand the statistical way of thinking, the concept of uncertainty and the connection between research design and statistical analysis, but also to know the common errors in statistical analysis and to critically evaluate the statistical methodology of clinical trials. The lectures are supplemented by practical exercises of applied statistical analysis with the use of statistical software.*

### **iii. Policy making policies in Greece**

The Hellenic National Strategy for Artificial Intelligence was concluded on December of 2020 but it is not yet published. The strategy developed by a multidisciplinary team of Greek Scientists and AI Experts under the auspices and supervision of the Ministry of Digital Governance. The strategy is aligned to the EU policies and recommendations for AI, as well as to relevant initiatives (e.g., the EU HLEG expert group, Council of Europe on AI (CAHAI), AI4EU, AI4People). Moreover, its development has considered international best practices from the strategies of other EU-27 countries and the UK, as well as from other prominent AI strategies outside the EU. However, the development of the AI Strategy is primarily driven by the socio-economic priorities of the country, including:



- Economic Growth
- Digital Transformation
- Boosting EU Values and Fundamental Rights

To successfully address the above listed socio-economic priorities the strategy sets three top-level objectives being:

- A Strategy for AI-based Economic Growth
- Accelerated Transformation of the Greek Public Sector
- “AI Democratization” with Greece in a Leading Role

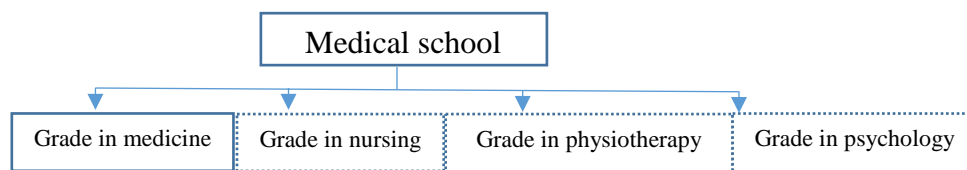
In parallel a number of actions are being developed in Greece concerning the AI strategy, in particular:

- White paper on Greek AI Strategy ([link](#))
- Sectoral Scientific Councils - ESETEK advises in a policy-making level for topics such as AI and Data Policy
- Greece participates in a discussion about AI and ethics organized by UNESCO ([link](#))
- Finally Greece is represented by a partner of AIIS project, SciFY, as an expert on AI in the «DIGITAL SME Focus Group on AI» is an initiative of the European Commission (AI Watch) and the European DIGITAL SME Alliance where they have set up a team composed of almost 40 AI experts representing companies from all over Europe ([link1](#), [link2](#)). The goals of the focus group are:
  - Monitoring the development, adoption and impact of AI by companies
  - Providing immediate feedback on their policies and regulatory needs

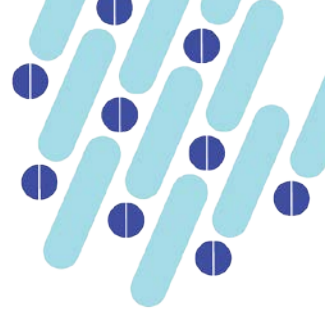
#### d. Desk Research of Spain

##### i. National Curricula in Spain

###### 1. Structure



*Medical school may have other names like “Health sciences faculty”. In dotted line grades that usually have their own faculty but may or may not be taught in the faculty of medicine. Other health sciences grade like nutrition, biomedicine, biomedical*



engineering, etc., may be taught in this faculty.

The grade in medicine in Spain consists in a 6-year degree. The national curriculum ([link](#)) consists in a list of core subjects with their respective ECTS that must be included in the particular curricula of each university. This national core curriculum has a total of 160 ECTS, so each university has room to include in their curricula the subjects they may consider since the grade usually has a total of 360 ECTS.

The core subjects of the grade are organized in 2 stages with the next subjects:

Stage 1: psychological bases of health and illness states; structure, function, morphology and development of the systems of the human body; general epidemiology and demography; introduction to medicine and scientific methodology (this includes a subject in biostatistics); introduction to the pathology; cellular, molecular, tissular and organic morphology and structure of human body.

Stage 2: legal medicine and toxicology; preventive medicine and public health; medicine and surgery of systems; obstetrics and gynecology; pediatric; psychiatry.

## 2. Courses (Undergraduate)

### 1. **Artificial intelligence and health. Grade in medicine, Universidad Autónoma de Barcelona**

A theoretical course to know the basics of artificial intelligence (machine learning, deep learning, big data) applied in medicine and other subjects related with technology (robotics, digital health, internet of things) and healthcare. Elective Subject

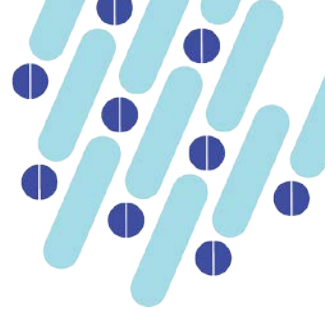
### 2. **Omics techniques and bioinformatics. Grade in medicine, Universidad de Sevilla**

Study of omics techniques and an introduction to bioinformatics. Required subject ([link](#))

### 3. **Big data and artificial intelligence in medicine. Grade in medicine, Universidad Complutense de Madrid**

There is no information about the contents and outcomes of the course. It is expected to be similar to the course described in 1.2.3, Elective Subject ([link](#))

### 4. **Online training program Boost your future**



Know and develop the most demanded skills for employability,  
<https://empleo.usal.es/format/cursos.php>

### 3. Courses (Postgraduate)

1. **New techniques of analysis of massive data. Master in healthcare economy, management and rational use of medication. Universidad de Málaga.**

A course on big data, data minning, Business intelligence, machine learning and its applications in healthcare. ([link](#))

2. **Knowledge transfer, patentability, and protection of knowledge policies. Master in translational research and personalized medicine. Universidad de Granada.**

The course is focused on intellectual property, innovation and transfer of knowledge in the medicine area. Furthermore, the course has contents related with entrepreneurship, research project management or comercialization of the results of research. ([link](#))

3. **Nursing and communication. Master in medical attention, management and care. Universidad de Santiago de Compostela**

The course is focused on the importance of the social skills in the medical practice. ([link](#))

4. **Introduction to programming and bioinformatics data analysis. Master in genomics and genetics. Universidad de Santiago de Compostela**

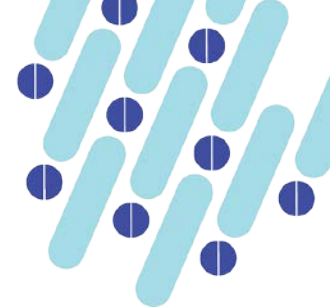
The course offers an introduction to bash/shell, R and Python programming languages to manage and analyze omics data. ([link](#))

5. **Scientific Writing and Communication Skills for Scientists. Master molecular biology and biomedicine. Universidad de Cantabria**

This course aims at providing the necessary techniques and concepts for efficient oral and written communication at different stages of scientific career development. ([link](#))

6. **Biomedical informatics: image and communications. Master in biomedical engineering. Universidad del País Vasco**

A course on computer vision focused on medical imaging. ([link](#))



## ii. Vocational Education Training in Spain

### 1. Structure

We did not find a specific structure for Medical VET programs. On one hand, there are not-official masters and courses offered by the university to students and mainly graduates in medicine. These courses have a master structure, with approximately 50 ECTS, 10 subjects, a final project and a duration of 1 year. On the other hand, there exist many VET courses offered by the universities to all the students and even external people, which consist in a specific course with 3 to 5 ECTS approximately.

In the same way, there are no specific curricula of VET education, since every university can offer their own not-official post-graduate programs and VET courses for students.

### 2. Courses

#### 1. **“Expert at modelling and data mining (with R software)”**

**Universidad de Castilla La Mancha ([link](#))**

A non-official grade on different topics of data science as data visualization, data mining, model generation or business analytics based on R language. The target of the course is any professional or graduated student. The course can be expanded to a non-official master degree of 60 ECTS.

#### 2. **Expert in eHealth and technological development for health use.**

**Universidad de Oviedo ([link](#))**

Non-official title with contents related with the use of technology in healthcare, with topics like eHealth, augmented reality, 3d printing, data science, apps, digital tools, social networks and gamification. Also contents about the legal and ethical aspects of this technologies.

#### 3. **Effective management of conflicts at the working environment.**

**Universidad de la Laguna ([link](#))**

A course about conflict management and resolution at the work environment

#### 4. **University Expert in patient security, organization and teams.**

**Universidad de Cádiz ([link](#))**

A course focused on the importance of the patient security mainly for students and graduates oriented to work on the health area. Some contents are related with management skills and leadership.





**5. University Expert in entrepreneurship and innovation. Universidad de Cádiz ([link](#))**

*A course about entrepreneurship and innovation oriented for graduates and students with no background in management and business*

**6. Introduction to scientific and technologic dissemination. Universidad de Extremadura ([link](#))**

*A course on scientific dissemination with the objective of bringing the science to society.*

**iii. Policy making policies in Spain**

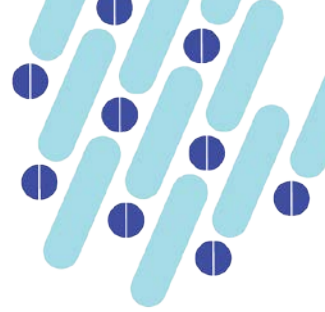
Estrategia Española de Ciencia, Tecnología e Innovación 2021-2027: Among the strategic lines we can find “precision medicine” and the following sublines, “artificial intelligence” and “digital health in personalized medicine”. “Artificial intelligence and robotics” is also a strategic line on its own, including “computer vision” and “digital health” as sublines.

Estrategia Española de I+D+i en Inteligencia Artificial: Describes primary care as a sector which will benefit from AI, and the focus in cost savings through improvements prevention, early diagnosis and treatment of child obesity, cardiovascular diseases, neurogenerative diseases and breast cancer, among other subjects. It states the need for an AI able to explain its decision to health professionals and improving the interaction human-computer. “P4 medicine” (predictive, personalized, preventive and participative) will be based on AI, big data, machine learning and computer vision.

“Estrategia Nacional en Inteligencia Artificial”: Identifies the synergy between the health sector and AI as a strategic field for research. It states that AI will drive strategic projects like simplification of algorithms in healthcare, such as patient triage, and improve the efficiency of the healthcare system.

## 6. Conclusion

1. The courses of artificial intelligence in the curricula of medical schools are not considered as a whole. AI and some of its topics are presented in fragments or not at all. Hence the need for a curriculum that will cover the full spectrum of conflicting intelligence. It will start with learning the basic concepts and will continue with the applications. It is VERY essential to emphasize that the existing individual AI courses do not offer substantial training to the students in the various fields they need to be connected to the physical subject of medicine.



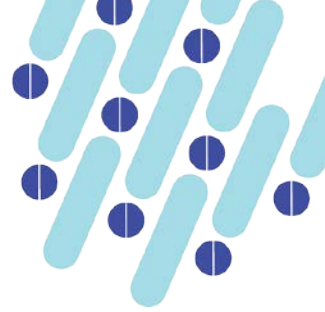
2. Soft skills courses are practically absent (except in Belgium and Spain), basic skills such as problem solving etc. are ignored.
3. The results of our research are fully in line with the results of the OECD for which only a few countries (Belgium, Denmark, Finland, the Netherlands, Norway, Sweden) are considered to have the necessary digital skills and appropriate education and lifelong learning systems to allow full and timely use of the possibilities and challenges of artificial intelligence. Research shows that both medical personnel and students often have deficient digital skills; therefore, lifelong learning systems, both formal and informal, need to be significantly strengthened to facilitate capacity building and the acquisition of the new skills needed in the future digital world of artificial intelligence.
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 need. Digital technologies - having invaded all fields of medicine - are radically shaping the ways of life, work and education. They can thus be an ideal ally for tackling everyday pressing challenges. Understanding the issue and coordinated action, through lifelong learning, can build more inclusive, more equitable and more sustainable societies, where everyone will be able to take advantage to the fullest in this new digital age, its potential and skills for a more sustainable development.

## 7. Annex

The full results of the survey are extract as follow:

- **Results for all the countries combined here:**  
<https://drive.google.com/drive/folders/1H9pVIUrZVBSElrmdxMgQM5KnwKO8gFrX?usp=sharing>
- **Results of Spain here:**  
[https://drive.google.com/drive/folders/1K0O78A\\_AKoSObr12Dwto3Xm4ueAaRDDY?usp=sharing](https://drive.google.com/drive/folders/1K0O78A_AKoSObr12Dwto3Xm4ueAaRDDY?usp=sharing)
- **Results of Belgium here:**  
<https://drive.google.com/drive/folders/1nn3QPBBocXJT8SaVDfZbu-6EgXjBqd0U?usp=sharing>





- Results of Finland here:  
[https://drive.google.com/drive/folders/1yQ\\_VbQ6lZARVhdikjGrrXD6lwub4dL9i?usp=sharing](https://drive.google.com/drive/folders/1yQ_VbQ6lZARVhdikjGrrXD6lwub4dL9i?usp=sharing)
- Results of Greece here:  
<https://drive.google.com/drive/folders/1bDczpuCNpOGSWgP-FpE1PzkwVxiVqLb0?usp=sharing>