AI2MED

Artificial Intelligence in Medical Care: Reducing Errors and Saving Lives

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AI2MED

Project 101140217

D4.1: Cross-sectoral multidisciplinary curricula for HEI/VET learners on AI-in-MED skills

Partner:	Institute Jožef Štefan (IJS)
Work Package:	Work package 4: Building HEI and VET curricula for AI&MED
Task:	Devising HEI and VET curricula for AI-in-MED
Due date:	28/02/2025
Work package Leader:	Institute Jožef Štefan (IJS)

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DOCUMENT HISTORY		
Version	**Date**	**Changes**
1.1	27/02/2025	**First version of the document.**
1.2	28/02/2025	**Final version of the document.**

DISSEMINATION LEVEL		
PU	Public, fully open	X
SEN	Sensitive (limited under the GA conditions)	
CLASS	EU classified, confidential	

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Executive summary

The **AI2MED project** is transforming healthcare education by developing cross-sectoral, multidisciplinary curricula that equip learners with the AI competencies necessary for the medical field. Deliverable 4.1 focuses on designing integrated curricula for both Higher Education Institutions (HEI) and Vocational Education and Training (VET) learners, ensuring a comprehensive approach to AI-in-MED skill development.

This report outlines the structure of the proposed curricula, incorporating findings from cross-sectoral research and expert consultations. The curricula are designed to bridge the gap between healthcare and AI, providing learners with both theoretical knowledge and hands-on experience in AI applications for diagnostics, clinical workflows, and patient management.

For HEIs, the curricula emphasize advanced skills such as AI-driven decision-making, data analytics, and ethical considerations, preparing students to become leaders in AI-integrated healthcare environments. VET curricula, on the other hand, focus on practical AI applications, ensuring that support staff and technical professionals can effectively collaborate with AI systems in medical settings.

This document also addresses the need for adaptable learning pathways that cater to various professional backgrounds, promoting lifelong learning in AI and healthcare. By integrating AI literacy with sector-specific expertise, AI2MED aims to enhance workforce readiness, improve patient outcomes, and strengthen Europe's position in AI-driven medical innovation.

1 Introduction

Artificial Intelligence (AI) is transforming the healthcare landscape by revolutionizing diagnostics, enhancing patient safety, and optimizing clinical workflows. As these advancements continue to shape modern medicine, it is essential to equip healthcare professionals with the necessary skills to effectively adopt and integrate AI technologies. This report, developed under the AI2MED project, presents cross-sectoral, multidisciplinary curricula designed to provide Higher Education Institutions (HEI) and Vocational Education and Training (VET) learners with structured learning pathways for AI-in-MED skills.

This deliverable builds upon the research conducted in Work Package 2 (WP2) and aligns with the recommendations outlined in Deliverable 2.3. Recommendations for HEI/VET curriculum and syllabus development. These previous efforts identified key AI skill gaps, analysed regional disparities, and formulated strategies for AI adoption in healthcare education. The curricula proposed in this report address these findings by integrating both theoretical and practical approaches, ensuring AI readiness across various levels of expertise. The curricula structured in this document will serve as a foundation for the creation of MOOCs within task 4.4 of Work package 4.

The objectives of this report include defining essential AI competencies for healthcare professionals, designing interdisciplinary educational frameworks, and ensuring that both HEI and VET learners acquire relevant, future-proof skills. By leveraging insights from industry experts and educational institutions, the curricula emphasize AI applications in diagnostics, patient management, medical ethics, and regulatory compliance.

Through structured learning modules, practical case studies, and hands-on AI training, this report aims to foster an AI-ready workforce capable of leveraging AI advancements to improve healthcare delivery. By implementing these curricula, AI2MED contributes to the broader goal of ensuring Europe remains a leader in AI-driven medical innovation.

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2 Curricula for HEI in MED

The integration of AI into healthcare requires a workforce that is not only technically proficient but also capable of ethical decision-making and interdisciplinary collaboration. To address this need, AI2MED has developed a set of specialized curricula for Higher Education Institutions (HEIs), equipping future healthcare professionals with the knowledge and skills necessary to leverage AI effectively.

These curricula cover key areas such as data management and cybersecurity, advanced digital competencies, interpersonal and cross-disciplinary communication, and AI ethics and oversight. Each curriculum module has been carefully designed to provide a balanced mix of theoretical foundations and practical applications, ensuring that students gain hands-on experience with AI-driven tools while understanding their broader impact on clinical decision-making, patient privacy, and healthcare workflows.

By integrating these curricula into HEI programmes, AI2MED aims to foster a new generation of healthcare professionals who are not only AI-literate but also capable of leading responsible AI adoption in medical settings. This chapter presents an in-depth overview of the four HEI curricula and their relevance in preparing students for AI-integrated healthcare environments.

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COURSE SYLLABUS	
Course title:	Data Management and Cybersecurity

Study programme and level	Study field	Academic year	Semester
	Healthcare		

Course type	Obligatory/ Non-obligatory
University course code:	

Lectures	Seminar	Tutorial	Clinical Work	Other forms of study	Individ. work	ECTS
5	5			10	10	1

Lecturer:	n/a
Languages:	English
Tutorial:	English/ national language

Prerequisits:

- Basic knowledge of healthcare systems, data management, and cybersecurity concepts
- Familiarity with electronic health records (EHR) systems
- Understanding of healthcare privacy laws and industry regulations (e.g., HIPAA, GDPR)
- Strong analytical problem-solving, critical thinking, and communication skills

Content (Syllabus outline):

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Module 1: Introduction to data management

This module offers a comprehensive overview of data management, focusing on its crucial role in healthcare organizations. It explores the fundamental processes of data ingestion, storage, organization, and maintenance, emphasizing how these practices can be effectively applied to the vast amounts of information generated and collected by health-related institutions. By mastering these concepts, participants will gain valuable insights into managing healthcare data efficiently and securely, ultimately improving organizational operations, and patient care.

Unit 1: Introduction to Data economy and the implication for healthcare

This unit provides a general overview on the so-called data society, focusing on the growing importance of data as a valuable asset in the modern economy and in specific sectors, such as , healthcare. It describes and discuss the way data analysis are transforming healthcare in terms of business models, products/services, and research, not forgetting the importance of ethical, legal, and privacy issues, which come with the data-driven economy.

Unit 2: The importance to ethically manage data in healthcare

This unit introduces participants to the criticalities associated to the management of sensitive health information in terms of ethics and responsibility. It explores key ethical principles such as privacy, consent, fairness, and transparency in healthcare data management, and presents some practical applications. The unit also addresses the potential consequences of unethical data practices and provides guidance on developing and implementing specific ethical frameworks for data governance.

Unit 3: Data Quality and Security

This unit focuses on the critical aspects of managing health data in an accurate, reliable, and protected way. It presents strategies and tools for ensuring data quality throughout its lifecycle, including data cleansing, validation, and standardization techniques. The unit also delves into essential security measures to safeguard sensitive health information against unauthorized access, breaches, and cyber threats, emphasizing the importance of maintaining both data integrity and patient confidentiality.

Unit 4: Data Storage and Organization

This presents and discuss some methods and technologies for efficiently storing and structuring healthcare data. It covers different types of database systems, including relational and non-relational ones, and discusses how to choose the most appropriate storage solutions for different types of medical data. The unit also presents some best practices for creating scalable and flexible data architectures dedicated to healthcare.

Module 2: Healthcare Data Governance

This module provides a comprehensive overview of data management principles and practices focusing on the peculiarities of the healthcare sector. It focuses on the effective policies, procedures, and standards for handling sensitive medical information throughout its lifecycle. The course covers key topics such as the implementation of governance frameworks in healthcare organizations. Participants will gain practical skills to develop and maintain robust data governance strategies, ensuring the integrity, security, and ethical use of healthcare data.

Unit 1: Foundations of Healthcare Data Governance

This unit introduces the fundamental concepts and principles of data governance within the healthcare context. It explores the key components of a robust data governance framework, including roles and responsibilities, policies and procedures, and decision-making structures. The unit also emphasizes the importance of aligning data governance practices with organizational goals, regulatory requirements, and

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ethical standards in healthcare, providing a solid foundation for effective data management in healthcare organizations.

Unit 2: Introduction to Data Governance Strategies

This unit provides a comprehensive overview of the most common approaches used to managing and governing data within health organizations. It covers key components of effective data governance, including policy development, stakeholder engagement, and the establishment of data stewardship roles. The unit also explores different governance models and frameworks, for making participants able to better understand how develop specific data governance strategies.

Unit 3: Healthcare data life cycle

This unit presents and discusses the healthcare "data journey" from its creation or acquisition through its utilization, storage, archival or disposal. It covers each stage of the data life cycle, with a focus on the unique characteristics and challenges of healthcare sectors. The unit also addresses the importance of maintaining data quality, security, and compliance throughout the entire life cycle.

Unit 4: Data compliance in healthcare

This unit focuses on the legal and regulatory requirements related to health data collection, use, and protection. It covers key regulations such as HIPAA, GDPR, and other relevant data protection laws, explaining their implications for healthcare organizations and data management practices. The unit also addresses strategies for achieving and maintaining compliance, including risk assessment, policy development, staff training, and auditing processes, to ensure a legal and ethical compliance.

Module 3: Secure Health Information Systems and Interoperability

This module introduces participants to one of the main challenges in data management, the security of data and information. It covers essential topics such as cybersecurity measures, data protection strategies, and interoperability standards with a specific focus on healthcare sector. Participants will understand how to design, implement, and manage a secure health information system with no risks for patient privacy and regulatory compliance.

Unit 1: Fundamentals of Health Information Systems Security

This unit provides a comprehensive overview of essential security concepts and practices with a focus on healthcare peculiarities. It covers key areas such as access control, encryption, network security, and incident response, with a focus on protecting sensitive patient data and maintaining the integrity of health information systems. The unit also addresses emerging healthcare security challenges, including mobile services security, cloud computing risks, and the growing threat of ransomware attacks.

Unit 2: Interoperability Standards and Protocols in Healthcare

This unit explores the key standards and protocols for a seamless data exchange between different healthcare systems and organizations. It presents and discusses the major and most common interoperability standards. The unit also addresses the challenges and benefits of achieving interoperability in healthcare, including improved patient care coordination, enhanced data analytics capabilities, and more efficient health service delivery.

Unit 3: Secure Data Exchange and Integration

In this unit focuses on the methods, tools, and technologies used to safely transfer and combine healthcare data across different systems and organizations. It covers secure data exchange protocols, encryption techniques, and integration strategies essential for ensuring data integrity and patient privacy during information sharing. The unit also addresses challenges in secure data exchange, such as managing consent, ensuring data accuracy, and implementing appropriate access controls.

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Unit 4: Risk Management and Compliance in Health

The unit focuses on the critical process of risks' identification, assessment, and mitigation risks associated with healthcare information technology systems. It covers key compliance requirements and explores specific risk management strategies designed for healthcare organizations. The unit also addresses risk assessments and mitigation strategies to ensure the security and integrity to health information systems.

Module 4: Developing a healthcare data management strategy

This module introduces participants to the development and implementation of an effective data management strategies designed for healthcare organizations. It covers the entire process from assessing organizational needs to designing and implementing a comprehensive data management framework. This module also focuses on the importance of data governance, quality control, and continuous improvement in managing healthcare data. Participants will learn to align data management practices with organizational goals, regulatory requirements, and technological advancements.

Unit 1: Fundamentals of a data management strategy

This unit introduces the core concepts and components essential for developing an effective health data management strategy. It covers key elements such as data governance, data quality management, metadata management, and data architecture. The unit also emphasizes the importance of aligning data management strategies with organizational goals and business processes, providing participants with the foundational knowledge needed to develop and implement successful data management initiatives.

Unit 2: Assessing Healthcare Data Needs and Challenges

This unit focuses on identifying and evaluating the specific requirements and obstacles that healthcare organizations must address dealing with data management. It presents the main methods and frameworks for conducting comprehensive data audits, stakeholder interviews, and gap analyses to determine current data capabilities and future needs.

Unit 3: Designing and implementing a Comprehensive Data Management Framework

This unit prepares participants to manage the design and development of a robust data management strategy tailored to healthcare organizations. It covers key components such as data governance structures, data quality protocols, metadata management, and data architecture design. The unit also addresses practical implementation considerations, including change management, stakeholder engagement, and the phased rollout of data management initiatives.

Unit 4: Evaluating and Optimizing Data Management Strategies

This unit presents the most common approaches to the implementation of data management strategies. It covers key performance indicators, measurement techniques, and benchmarking practices to evaluate the success of the strategies in healthcare settings. The unit also presents some improvement methodologies, including feedback loops and iterative optimization processes, enabling participants to refine and enhance their data management approaches.

Objectives and competences:

General competences

Understanding AI fundamentals: Explain the core concepts of AI (e.g., machine learning, neural networks) and their relevance to medicine.

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Data literacy: Navigate and interpret medical datasets (e.g. patient records, imaging data) for AI applications.

Human-AI collaboration: Work effectively with AI tools to improve clinical workflows (e.g. diagnostics, patient monitoring).

Problem solving: Apply AI insights to address real-world medical challenges (e.g. treatment planning, resource allocation).

Adaptability: Adapt workflows to integrate new AI technologies while maintaining standards of patient care.

Specific competences

Healthcare Data Governance: ability to design and implement healthcare data governance frameworks.

Healthcare Regulatory Compliance: understanding of healthcare-specific regulations (e.g., HIPAA, HITECH)

Pre-process medical data: Clean and structure data sets (e.g. lab reports, EHRs).

Clinical Data Quality Management: maintain the integrity and accuracy of clinical data.

Data Ethics: Understanding of privacy-preserving data mining techniques for healthcare.

Soft competences

(Interpersonal and transferable skills)

Critical thinking: Question and scrutinize results of automated data management systems.

Communication: Explain data management goals and techniques to stakeholders in clear and non-technical language.

Teamwork: Collaborate with colleagues on data management strategies

Ethical awareness: Recognise the ethical implications of dealing with personal medical data

Time management: Create a balance between the integration of automated and human-based systems.

Intended learning outcomes:

Module 1: Introduction to data management

- Understand the fundamental concepts and principles of data management, including its importance in organizational decision-making and operations.
- Recognize the importance of data governance for efficiently and effectively approach policies, procedures, and roles for data stewardship.
- Recognize the best data storage technologies and organization methods for different data types and use cases
- Understand how to implement techniques for data cleansing, validation, and standardization
- Aquire the basics of data security and privacy, including common threats and essential protective measures in data management practices

Module 2: Collaboration with AI systems

- Understand the principles of data governance in healthcare context

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- Use healthcare-specific data governance frameworks that align with regulatory requirements (e.g., HIPAA, GDPR) and organizational goals
- Understand how to develop and implement policies and procedures for managing sensitive patient data throughout its lifecycle
- Recognize and evaluate data quality in healthcare settings, ensuring the accuracy and reliability of clinical and administrative data for decision-making and patient care

Module 3: Secure Health Information Systems and Interoperability

- Understand the fundamental principles of security in health information system.
- Develop proficiency in implementing and managing secure data exchange protocols and technologies in healthcare settings.
- Understanding healthcare interoperability standards (e.g., HL7, FHIR, DICOM) and their integration possibilities.
- Understand how ensure and evaluate compliance with relevant healthcare data protection regulations.
- Recognize and test the secure architectures for health information systems

Module 4: Developing a healthcare data management strategy

- Understand the importance of data management in healthcare and its impact on patient care, operational efficiency, and research.
- Implement data governance frameworks and processes to ensure data quality, security, and privacy.
- Recognize data analytics tools and techniques to extract insights from healthcare data for decision-making.
- Evaluate and select appropriate technologies and infrastructure for healthcare data management.

Learning and teaching methods:

Learning methods

Case studies. Participants will analyse real medical cases to understand how AI helps with diagnoses and decision-making processes.

Practical exercises. Participants engage with AI tools such as symptom checkers or diagnostic assistants to practise interacting with medical technologies.

Role plays and simulations. In role plays, participants practise the use of AI in the clinical environment, e.g. when interpreting laboratory results or communicating with patients.

Joint project work. Participants work together to develop AI-driven solutions, such as risk predictors for heart disease or AI-assisted care plans.

Problem-based learning (PBL). Participants solve real-world problems, such as improving AI accuracy or validating AI recommendations, by adjusting training parameters or adding new data.

Discussions and reflection. Group discussions encourage participants to reflect on the ethical implications, limitations and potential risks of AI in healthcare.

Teaching methods

Direct instruction and demonstrations. Educators provide basic knowledge of AI systems and demonstrate the use of AI tools.

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Guided practise. Educators provide step-by-step instructions and guidance as participants create AI models and prototypes.

Interactive lectures and discussion sessions. Educators lead discussions to help participants understand the role of AI in healthcare.

Peer collaboration and feedback. Participants are encouraged to collaborate, share ideas and give each other feedback on their work.

Case studies and real-world scenarios. Educators present real-world healthcare case studies to illustrate how AI is used to solve complex medical challenges.

Experiments and tests. Educators guide participants through the process of testing and improving AI models, for example by evaluating the accuracy of AI in diagnosing diseases such as pneumonia or breast cancer.

Assessment:	Weight (in %)
Participation and quizzes	30
AI in healthcare use case scenario analysis and presentation	40
Final exam	30

Lecturer's references:

Mandatory readings

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Aloqaily, M., Kanhere, S., Bellavista, P., & Nogueira, M. (2022). Special issue on cybersecurity management in the era of AI. *Journal of Network and Systems Management*, *30*(3), 39.

Sarker, I. H., Kayes, A. S. M., Badsha, S., Alqahtani, H., Watters, P., & Ng, A. (2020). Cybersecurity data science: an overview from machine learning perspective. *Journal of Big data*, *7*, 1-29.

ara, H. L. S., Navarro, H. B. P., & Armas-Aguirre, J. (2020, October). Cybersecurity and privacy capabilities model for data management against cyber-attacks in the health sector. In *Brazilian Technology Symposium* (pp. 359-367). Cham: Springer International Publishing.

Khang, A., Ragimova, N. A., Hajimahmud, V. A., & Alyar, A. V. (2022). Advanced technologies and data management in the smart healthcare system. In *AI-Centric Smart City Ecosystems* (pp. 261-270). CRC Press.

Kelly, B., Quinn, C., Lawlor, A., Killeen, R., & Burrell, J. (2023). Cybersecurity in Healthcare. *Trends of Artificial Intelligence and Big Data for E-Health*, 213-231.

Kruse, C. S., Frederick, B., Jacobson, T., & Monticone, D. K. (2017). Cybersecurity in healthcare: A systematic review of modern threats and trends. *Technology and Health Care*, *25*(1), 1-10.

Optional readings:

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Admass, W. S., Munaye, Y. Y., & Diro, A. A. (2024). Cyber security: State of the art, challenges and future directions. *Cyber Security and Applications*, *2*, 100031.

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Rahim, M. J., Rahim, M. I. I., Afroz, A., & Akinola, O. (2024). Cybersecurity threats in healthcare it: Challenges, risks, and mitigation strategies. *Journal of Artificial Intelligence General science (JAIGS) ISSN: 3006-4023*, *6*(1), 438-462.

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COURSE SYLLABUS	
Course title:	Advanced Digital Competencies

Study programme and level	Study field	Academic year	Semester
	Healthcare		

Course type	Obligatory/ Non-obligatory
University course code:	

Lectures	Seminar	Tutorial	Clinical work	Other forms of study	Individ. work	ECTS
5		5		10	10	1

Lecturer:	
Languages:	English
Tutorial:	

Prerequisites:

Basic Computer Literacy

- Comfortable with operating systems (Windows, Mac, or Linux).
- Ability to install software and manage files (e.g., creating folders, unzipping files).

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- Familiarity with essential productivity tools (e.g., Microsoft Office/Google Workspace).

Foundational Statistics & Research Methods

- Understanding of basic statistical concepts (mean, median, standard deviation, p-values).
- Familiarity with research study designs, hypothesis testing, and interpreting results.
- Awareness of the importance of sample sizes, bias, and confounding variables in clinical research.

General Healthcare Knowledge

- Background in healthcare workflows (for practitioners) or basic clinical knowledge (for students).
- Familiarity with Electronic Health Record (EHR) systems and basic health data types (e.g., lab results, imaging, patient demographics).
- Understanding of common medical terminologies and coding systems (e.g., ICD, SNOMED).

Introductory Programming & Data Handling

- Experience with at least one data-friendly programming language (e.g., Python or R) is highly advantageous.
- Comfort with basic scripting and data manipulation (reading CSV files, filtering data, basic visualization).
- If no prior programming experience, a willingness to learn the basics quickly.

Communication & Collaboration Skills

- Ability to work in multidisciplinary teams, since advanced digital competencies often require collaboration with data scientists, IT professionals, and clinicians.
- Effective written and verbal communication to present data insights and technical findings clearly.

Content (Syllabus outline):

Initial sprint of prerequisite concepts that participants should be familiar with.

Module 1: Data Visualization

Unit 1: Introduction to Visualization Tools & Techniques

Overview of commonly used visualization platforms (e.g., Tableau, Power BI, R, Python libraries like Matplotlib and Seaborn).

Unit 2: Types of Medical Data & Formats

Examples include Electronic Health Records (EHR), imaging data, laboratory results, and real-time patient monitoring data.

Unit 3: Design Principles in Medical Contexts

Visual encoding, colour theory, chart selection (e.g., bar charts, heat maps, radial plots), and dashboard design specific to clinical settings.

Unit 4: Data Cleaning & Preprocessing for Visualization

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Handling missing values, data normalization, data transformation for improved clarity.

Unit 5: Interactive Visualizations & Dashboards

Techniques to create interactive, multi-layer dashboards that enable clinicians to drill down for more detailed patient insights.

Module 2: Predictive Analytics

Unit 1: Fundamentals of Predictive Modelling

Terminology (dependent/independent variables, overfitting, regularization), types of predictive models (regression, classification).

Unit 2: Statistical Techniques & Risk Scores

Logistic regression, Cox proportional hazards modelling, clinical risk scores (e.g., CHA_2DS_2-VASc).

Unit 3: Data Mining & Pattern Recognition

Identifying trends in large clinical datasets, such as hospital admission data or real-time wearable sensor data.

Unit 4: Validation Methods

Cross-validation, ROC curves, confusion matrices, sensitivity, specificity in a healthcare context.

Unit 5: Clinical Applications & Case Studies

Examples of predictive analytics in disease progression, readmission rates, resource allocation, and population health.

Module 3: Machine Learning

Unit 1: Overview of Machine Learning Algorithms

Supervised (regression, classification), unsupervised (clustering, dimensionality reduction), reinforcement learning.

Unit 2: Neural Networks & Deep Learning Basics

Foundational understanding of CNNs for imaging, RNNs for sequence data (e.g., EHR time-series).

Unit 3: Algorithmic Complexity & Model Optimization

Hyperparameter tuning, gradient descent, backpropagation, ensemble methods (e.g., random forests, XGBoost).

Unit 4: Workflow & Pipelines for Healthcare ML Projects

Data sourcing, cleaning, feature engineering, model training, validation, and deployment in clinical environments.

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Unit 5: Real-World ML Applications in Medicine

Diagnostic imaging analysis, predictive pathology, genomics, personalized treatment recommendations.

Module 4: Foundations on AI Impacts on Data Management & Clinical Outcomes

Unit 1: AI Governance and Regulatory Frameworks

Overview of relevant healthcare regulations (HIPAA, GDPR), data governance policies, and AI-specific guidelines.

Unit 2: Ethical Principles & Bias in AI

Fairness, accountability, and transparency; case studies illustrating biases in clinical decision support.

Unit 3: Data Security & Privacy Issues

Encryption, secure data transfer, anonymization, and strategies to minimize data breaches.

Unit 4: Clinical Workflow Integration

Best practices for embedding AI tools in existing clinical processes (e.g., EHR integration, telemedicine).

Impact on Healthcare Delivery & Patient Outcomes

Case studies on AI-driven clinical improvements (e.g., faster diagnoses, personalized treatments, reduced costs).

Objectives and competences:

Data Visualisation:

Select Appropriate Visualization Methods

Determine the best chart types or visual encodings for different categories of medical data.

Use Visualization Tools Proficiently

Gain hands-on experience with at least one major visualization tool (e.g., Tableau, Python, R).

Apply Design Principles to Clinical Data

Ensure visual clarity, usability, and relevance for diverse clinical stakeholders.

Critically Assess Data Quality

Identify common data quality issues in medical contexts and understand how they affect visualization outcomes.

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Develop Interactive Reports

Incorporate filters, dynamic elements, and dashboards tailored for healthcare decision-making.

Predictive Analytics

Explain Key Predictive Analytics Concepts

Show understanding of how predictive models generate insights from historical data.

Conduct Predictive Modelling Experiments

Use tools (e.g., Python's scikit-learn, R's caret) to build and test models on medical datasets.

Interpret Model Performance Metrics

Understand and apply measures such as AUC (Area Under the Curve), accuracy, precision, and recall.

Assess Clinical Utility of Predictive Models

Evaluate how well a model's predictions translate to improved patient outcomes or cost savings.

Incorporate Ethical & Bias Considerations

Identify ways in which predictive models might perpetuate biases or inequalities in healthcare.

Machine Learning

Differentiate ML Techniques

Distinguish between classification, regression, clustering, and reinforcement approaches in medical contexts.

Develop Basic ML Models from Scratch

Use Python frameworks (e.g., TensorFlow, PyTorch, scikit-learn) for model building.

Implement Feature Engineering

Transform and select relevant medical data features for model improvement.

Evaluate Deep Learning Models

Understand metrics unique to neural networks, such as IoU for image segmentation in radiology.

Address Challenges in Medical ML

Recognize issues like data imbalance (rare diseases), ethical concerns, privacy, and the need for explainability.

Foundations on AI Impacts on Data Management & Clinical Outcomes

Identify Key Regulatory & Compliance Requirements

Understand the legal and ethical boundaries surrounding AI in medicine.

Recognize and Mitigate Biases

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Develop strategies to minimize algorithmic bias in clinical practice.

Implement Secure AI Solutions

Ensure robust data encryption, secure architectures, and audit trails for AI-driven systems.

Facilitate AI Adoption

Understand change management principles for successful AI integration within health institutions.

Evaluate AI's Role in Patient-Centered Care

Assess whether AI tools genuinely improve patient outcomes, quality of care, or cost efficiency.

Intended learning outcomes:

Data Visualisation:

Create Clear, Actionable Medical Data Visuals

Learners can produce dashboards that highlight key metrics (e.g., patient outcomes, population health trends).

Demonstrate Proficiency in a Leading Visualization Tool

Learners can navigate and apply advanced features such as calculated fields, parameters, and interactive elements.

Promote Data-Driven Decisions in Clinical Practice

Learners can use visual evidence to influence and guide patient care strategies.

Communicate Findings to Non-Technical Stakeholders

Learners can simplify complex data into user-friendly visuals for clinicians, patients, and administrators.

Ensure Compliance and Patient Privacy

Learners can integrate ethical and legal standards (e.g., HIPAA, GDPR) into data presentations.

Predictive Analytics

Design and Implement Predictive Models

Learners can craft predictive solutions for common clinical problems using appropriate tools and techniques.

Critically Evaluate Model Outputs

Learners can interpret and challenge model results, identifying potential pitfalls like overfitting or bias.

Make Data-Driven Clinical Decisions

Learners can integrate predictive analytics into care pathways for evidence-based decision-making.

Communicate Predictive Insights to Medical Teams

Learners can present the implications of predictive findings, facilitating multidisciplinary discussions.

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Advocate for Ethical Deployment of Predictive Analytics

Learners can ensure transparency, fairness, and adherence to medical standards when adopting predictive tools.

Machines Learning

Build and Deploy Working ML Models in Healthcare

Learners can produce prototypes that classify or predict health-related outcomes.

Interpret Model Decisions Responsibly

Learners can explain how an ML model arrived at a conclusion, enhancing trust in clinical settings.

Collaborate with Interdisciplinary Teams

Learners can work with data scientists, clinicians, and IT professionals to integrate ML solutions.

Innovate in Diagnostics and Treatment

Learners can leverage ML to generate novel insights, improving patient monitoring and care.

Ensure Compliance and Mitigate Risks

Learners can anticipate legal, ethical, and technical challenges in adopting ML in healthcare.

Foundation on AI Impacts on Data Management and Clinical Outcomes

Advocate for Ethical AI in Healthcare

Learners can articulate key ethical concerns and propose practical solutions.

Comply with Regulatory Standards

Learners can design and operate AI systems that meet legal and professional guidelines.

Enhance Security and Confidentiality

Learners can implement protocols that protect sensitive patient data while using AI tools.

Promote AI-Driven Innovations

Learners can champion adoption of AI solutions that demonstrate real clinical value and safety.

Foster Sustainable AI Practices

Learners can encourage ongoing monitoring, maintenance, and iterative improvement of AI solutions in healthcare contexts

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Learning and teaching methods:

- **Pre-Recorded Video Lectures**
  - **Description:** Short, focused presentations delivered by subject-matter experts.
  - **Benefit:** Allows for flexible viewing; learners can pause, replay, or speed up content according to their needs.
- **Live Webinars or Virtual Class Sessions**
  - **Description:** Synchronous online sessions using platforms like Zoom, Microsoft Teams, or Google Meet.
  - **Benefit:** Offers real-time interaction, Q&A, and direct feedback from instructors.
- **Interactive Quizzes and Formative Assessments**
  - **Description:** Auto-graded quizzes, polls, or short exercises embedded throughout the modules.
  - **Benefit:** Provides immediate feedback, enabling learners to identify knowledge gaps and track progress.
- **Discussion Forums & Peer-to-Peer Learning**
  - **Description:** Online discussion boards where learners can ask questions, share resources, and collaborate on problem-solving.
  - **Benefit:** Fosters community, encourages peer support, and enhances critical thinking through dialogue.
- **Case-Based Learning**
  - **Description:** Presentation of real or simulated clinical cases where learners apply data analysis, predictive modeling, or AI insights to clinical scenarios.
  - **Benefit:** Contextualizes theoretical knowledge in real-world settings, sharpening decision-making skills.
- **Project-Based Assignments or Mini-Capstones**
  - **Description:** Learners work (individually or in teams) on a data analytics or machine learning project relevant to healthcare.
  - **Benefit:** Encourages hands-on practice, deep learning, and the development of problem-solving skills.
- **Hands-On Tutorials and Demonstrations**
  - **Description:** Step-by-step guides showing how to use specific tools (e.g., Python libraries, Tableau, Power BI), with downloadable datasets for practice.
  - **Benefit:** Offers practical skill-building experiences; learners can follow along and replicate techniques.
- **Peer Review & Collaborative Feedback**
  - **Description:** Structured activities where learners critique and provide feedback on each other's work (e.g., project drafts, case study analyses).
  - **Benefit:** Develops critical appraisal skills, encourages reflection, and helps refine understanding through multiple perspectives.
- **Gamification Elements**
  - **Description:** Points, badges, leaderboards, or scenario-based challenges to motivate and reward learner engagement.
  - **Benefit:** Increases motivation, creates a sense of achievement, and fosters friendly competition among participants.
- **Reflections & Learning Journals**
  - **Description:** Learners keep a digital journal or submit reflective notes after each module/lesson, discussing insights and personal learning progress.
  - **Benefit:** Promotes self-awareness, long-term retention, and deeper integration of new knowledge.

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Assessment:

	Weight (in %)
1. Multichoice Quiz on Data Visualisation	10%
2. Multichoice Quiz on Predictive Analytics	10%
3. Multichoice Quiz on Machine Learning	10%
4. Multichoice Quiz on Impacts of AI on Medicine	10%
5. Case Study Analysis and Application of All Modules	60%

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COURSE SYLLABUS	
Course title:	Interpersonal and Cross-Disciplinary Communication

Study programme and level	**Study field**	**Academic year**	**Semester**
	Healthcare		

Course type	Obligatory/ Non-obligatory
University course code:	

Lectures	**Seminar**	**Tutorial**	**Clinical work**	**Other forms of study**	**Individ. work**	**ECTS**
5	5			10	10	1

Lecturer:	
Languages:	English
Tutorial:	

Prerequisits:

Medical Prerequisite:

Basic understanding of healthcare systems, medical terminology, and clinical procedures. Experience in patient care and familiarity with healthcare protocols.

Technical Prerequisite (AI-related):

Fundamental knowledge of artificial intelligence and its applications in healthcare. Basic digital literacy and ability to work with AI-powered tools in a medical setting.

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Content (Syllabus outline):

Module 1: Foundations of Interpersonal and Cross-Disciplinary Communication

This module introduces fundamental communication principles in both healthcare and AI contexts. It examines the challenges of interdisciplinary collaboration, including language gaps between AI developers and medical professionals, and explores how AI is integrated into healthcare communication workflows.

Unit 1: Fundamentals of Communication in Healthcare and AI

Explores the core principles of communication in medical and AI contexts, highlighting the differences between human-to-human and human-AI interactions.

- Lesson 1: Core principles of healthcare and AI communication
- Lesson 2: Differences between human-to-human and human-AI interactions

Unit 2: Common Barriers and Challenges in Interdisciplinary Communication

Identifies language and technical gaps between AI developers and healthcare professionals and provides strategies to overcome miscommunication.

- Lesson 3: Technical vs. medical language gaps
- Lesson 4: Overcoming miscommunication between AI developers and healthcare professionals

Unit 3: Communication Models in AI and Healthcare

Compares traditional and AI-assisted communication workflows and examines AI's role in supporting clinical decision-making.

- Lesson 5: Traditional vs. AI-assisted communication workflows
- Lesson 6: Role of AI in supporting clinical decision-making

Module 2: Ethical, Legal, and Patient-Centered Considerations in AI Communication

This module explores the ethical and legal dimensions of AI-driven communication in healthcare. Participants will analyze AI biases, privacy concerns, and regulatory requirements while learning strategies to ensure AI tools support, rather than replace, human-centered patient interactions.

Unit 4: Ethical and Legal Frameworks in AI-Driven Communication

Addresses ethical dilemmas, privacy concerns, AI biases, and regulatory requirements for AI-based communication tools.

- Lesson 7: Ethical dilemmas in AI-assisted communication
- Lesson 8: Legal considerations—privacy, bias, and responsibility in AI use
- Lesson 9: Regulatory requirements for AI-based communication tools

Unit 5: Patient-Centered AI Communication Strategies

Focuses on ensuring AI enhances, rather than replaces, human interaction, improving patient education, and mitigating AI-related communication risks.

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- Lesson 10: Ensuring AI improves—not replaces—human interaction
- Lesson 11: AI in patient education and engagement
- Lesson 12: Handling AI miscommunication risks in healthcare

Module 3: Effective Strategies for Communicating AI Solutions in Healthcare (6 lessons)

This module focuses on bridging the gap between AI developers and medical professionals by developing effective communication strategies. Participants will learn to simplify AI concepts, address skepticism, and leverage AI tools such as telemedicine and automated documentation to enhance healthcare communication.

Unit 6: Communicating AI Concepts to Medical Professionals (3 lessons)

Teaches how to explain AI concepts to non-technical audiences, address skepticism, and integrate AI discussions into medical education.

- Lesson 13: Simplifying AI concepts for non-technical audiences
- Lesson 14: Addressing skepticism and resistance to AI adoption
- Lesson 15: Strategies for integrating AI discussions into medical education

Unit 7: AI Tools for Enhancing Healthcare Communication (3 lessons)

Explores AI-driven documentation, telemedicine, and language translation tools to improve communication in healthcare settings.

- Lesson 16: AI-powered documentation and decision-support tools
- Lesson 17: AI in telemedicine and remote healthcare communication
- Lesson 18: AI-assisted language translation in global healthcare settings

Module 4: AI's Role in Reducing Errors and Improving Decision-Making in Healthcare (6 lessons)

This module explores AI's potential to minimize medical errors and optimize clinical decision-making. Through case studies and practical exercises, participants will evaluate AI's strengths and limitations, ensuring human oversight is maintained in AI-supported medical workflows.

Unit 8: Case Studies on AI's Impact on Medical Errors (3 lessons)

Examines real-world cases where AI has reduced diagnostic errors, improved treatment planning, and highlighted the need for human oversight.

- Lesson 19: Success stories of AI in reducing diagnostic errors
- Lesson 20: AI's role in improving treatment planning and care coordination
- Lesson 21: The limitations of AI—when human oversight is crucial

Unit 9: Designing AI Solutions for Safe and Effective Healthcare Communication (3 lessons)

Covers best practices for AI-assisted clinical workflows, human-AI collaboration in complex cases, and validation of AI recommendations.

- Lesson 22: Best practices in AI-assisted clinical workflows
- Lesson 23: Human-AI collaboration in complex medical cases

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- Lesson 24: Validating AI recommendations against clinical guidelines

Module 5: Continuous Learning and Professional Development in AI-Healthcare Communication

This module emphasizes lifelong learning and adaptation to AI advancements in healthcare. Participants will develop AI education materials, explore professional development strategies, and prepare for future AI-driven changes in medical communication.

Unit 10: Lifelong Learning in AI and Healthcare Communication

Encourages continuous learning to keep up with emerging AI trends and improve AI-driven communication skills.

- Lesson 25: Staying updated on emerging AI trends in healthcare
- Lesson 26: Continuous improvement in AI-driven communication skills
- Lesson 27: Self-assessment and reflective learning in AI adoption

Unit 11: Creating AI Education Materials for Healthcare Professionals

Focuses on developing AI literacy programs, interactive training methods, and preparing for future AI-driven transformations in healthcare communication.

- Lesson 28: Designing AI literacy programs for clinicians
- Lesson 29: Interactive and hands-on training approaches for AI in medicine
- Lesson 30: Future directions—how AI will transform healthcare communication

Objectives and competences:

General Competences

(Transferable skills)

Interdisciplinary Communication: Bridge the gap between healthcare and AI professionals by translating technical and clinical language effectively.

Ethical and Critical Thinking: Evaluate ethical, legal, and patient-centered implications of AI in healthcare communication.

Problem-Solving: Address communication challenges in AI integration and patient interaction.

Adaptability: Respond to new developments in AI and healthcare with flexible and strategic communication approaches.

Teamwork and Collaboration: Work effectively in interdisciplinary teams involving medical professionals, AI developers, and policymakers.

Specific Competences

(Technical and field-specific skills)

Understanding AI in Healthcare: Explain AI's role in diagnosis, treatment planning, and patient monitoring in non-technical language.

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Using AI for Communication: Utilize AI-powered tools (e.g., automated documentation, chatbots, medical language processing) to enhance healthcare communication.

Interpreting AI Outputs: Assess AI-generated recommendations and translate them into actionable insights for healthcare professionals.

Developing AI Communication Strategies: Design workflows and patient-centered communication models that integrate AI safely and effectively.

Error Reduction & Decision Support: Leverage AI insights to minimize medical miscommunication and optimize decision-making.

Soft Competences

(Behavioral and Interpersonal Skills)

Empathy in Communication: Ensure AI-driven interactions prioritize human connection and patient-centered care.

Clarity and Precision: Communicate complex AI-driven healthcare concepts in a clear and accessible manner.

Professional Development: Stay updated on AI advancements in healthcare and continuously refine communication skills.

Educational Competence: Develop training materials that help healthcare professionals understand AI-based tools and applications.

Intended learning outcomes:

Module 1: Foundations of Interpersonal and Cross-Disciplinary Communication

- Understand the foundational principles of interpersonal and cross-disciplinary communication within healthcare and AI contexts.
- Identify and address barriers to effective interdisciplinary communication in AI solutions for medical care.

Module 2: Ethical, Legal, and Patient-Cantered Considerations in AI Communication

- Evaluate the ethical and legal implications of AI applications in healthcare communication.
- Incorporate patient cantered approaches in designing AI communication tools.

Module 3: Effective Strategies for Communicating AI Solutions in Healthcare

- Demonstrate effective communication strategies for explaining AI-based solutions to healthcare professionals and vice versa
- Utilize advanced AI tools to improve accuracy and efficiency in healthcare communication while staying updated on trends in AI and healthcare.

Module 4: AI's Role in Reducing Errors and Improving Decision-Making in Healthcare

- Analyse case studies to explore how AI tools improve communication and reduce diagnostic or treatment errors.
- Apply knowledge of healthcare systems to design AI solutions that align with patient safety and care standards.

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Module 5: Continuous Learning and Professional Development in AI-Healthcare Communication

- Design strategies for continuous professional development in AI and healthcare communication.
- Develop personalized education materials to teach AI concepts effectively to healthcare professionals.

Learning and teaching methods:

Learning methods

Case studies - participants will analyze real-world AI applications in healthcare to understand the benefits and challenges of AI-driven communication.

Problem solving - learners will work in teams to solve AI-related communication challenges, such as bridging gaps between medical professionals and AI developers.

Simulations - practical exercises where participants practice AI-assisted patient communication, interpret AI-generated medical data, and refine AI outputs for clinical use.

Interactive discussions - group discussions on ethical, legal, and regulatory challenges in AI-driven communication, fostering critical thinking.

Hands-on exploration - participants will interact with AI-powered documentation, decision-support tools, and medical chatbots to improve communication workflows.

Teaching methods

Case studies - educators will present and analyze AI-driven healthcare cases, emphasizing both successes and failures.

Instruction and demonstrations - educators will explain AI concepts, demonstrate the use of AI tools in healthcare, and provide structured guidance.

Practical exercise - step-by-step AI tool applications, such as using AI in patient consultations, clinical decision-making, and medical education.

Group work - participants will engage in team-based tasks to develop AI-enhanced communication strategies and workflows.

Self-assessment and reflective learning - learners will regularly evaluate their understanding of AI communication and refine their approach through peer feedback and structured self-reflection.

Assessment:	Weight (in %)
Active engagement in discussions, simulations, and interactive exercises (quizzes).	20
Case study analysis and presentation	30
Practical AI communication task	25

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Final Exam	25

Lecturer's references:

Mandatory readings

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doi: 10.7759/cureus.73763.

Optional readings:

Bouderhem, Rabaï. 2024. "Shaping the Future of AI in Healthcare through Ethics and Governance." Humanities and Social Sciences Communications 11(1).

doi: 10.1057/s41599-024-02894-w.

Hayre, Christopher M., Dave J. Müller, and Marcia J. Scherer, eds. 2019. Everyday Technologies in Healthcare. [Place of publication not identified]: CRC Press.

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COURSE SYLLABUS	
Course title:	AI Ethics and Oversight

Study programme and level	Study field	Academic year	Semester
	Health professions		

Course type	Obligatory/ Non-obligatory
University course code:	

Lectures	Seminar	Tutorial	Clinical work	Other forms of study	Individ. work		ECTS
5		5		10	10		1

Lecturer:	
Languages:	English
Tutorial:	

Prerequisites:

None

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Content (Syllabus outline):

Module 1: Foundations of AI in Healthcare

This topic introduces students to the fundamental concepts of AI and its integration into healthcare systems. It covers the various types of AI technologies, including machine learning, deep learning, natural language processing, generative AI and robotics as well as discusses data sources utilised for AI in Healthcare and outcomes of human alone, AI alone and human + AI in healthcare to date and their practical applications in diagnostics, treatment, and administration. The topic takes both a clinical and systems-level perspective, helping students understand how AI impacts individual patient care as well as broader healthcare operations. Students learn to differentiate between different AI technologies while developing an understanding of their potential benefits and implications for both healthcare providers and patients. It also introduces the four principles of medical ethics and invites learners to start to consider their implications for the use of AI in healthcare settings.

Module 2: AI Risks

This topic delves into the critical examination of risks associated with AI implementation in healthcare settings, and considers those risks in terms of medical ethics. It addresses both immediate clinical risks, such as potential patient harm from AI errors and algorithmic bias, and broader societal concerns including the risk of AI increasing healthcare inequity. The content explores complex issues of AI transparency and accountability, particularly focusing on the challenges of "black box" decision-making in healthcare contexts. Advances in AI explainability are discussed. Students examine how AI might lead to the depersonalisation of healthcare but also how it may restore the "care" in healthcare and consider professional implications like potential job displacement and questions of legal liability. Furthermore, the risks of over-reliance on AI in healthcare systems and levels of automation suitable for healthcare are explored. Concerns surrounding cyber-security and data acquisition are addressed. This comprehensive risk assessment helps students develop the ability to critically evaluate AI systems' implementation in various healthcare scenarios.

Module 3: AI Healthcare Ethics and Law

This section bridges theoretical frameworks with practical applications, introducing students to both ethical principles and legal requirements governing AI in healthcare. It examines various ethical frameworks, including medical ethics, bioethics, and the European Commission's guidelines for AI. Students learn how these principles are translated into concrete legislation like the EU AI Act and GDPR. The topic introduces the concept of Ethics by Design, emphasising the importance of incorporating ethical considerations from the earliest stages of AI system development. This foundation helps students understand how ethical principles are operationalised in real-world healthcare settings.

Module 4: Application of EU Ethical AI Guidelines to Healthcare Context

This topic takes the theoretical understanding of ethics and applies it specifically to healthcare scenarios. It explores critical issues such as bias in healthcare AI systems and their implications for healthcare equity and access. Students examine how AI impacts healthcare disparities and consider environmental implications, including AI's role in both contributing to and potentially solving climate change challenges in healthcare. The section emphasises the importance of transparency in AI systems, patient consent, and data protection, helping students evaluate how these principles affect patient autonomy and privacy in practical healthcare settings.

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Module 5: AI Accountability, Safety and Governance

The final topic focuses on the practical implementation of safe and accountable AI systems in healthcare. It examines technical robustness and system vulnerabilities that could compromise patient safety. Students learn to perform ethical assessments of AI platforms in specific healthcare contexts and understand the importance of human oversight in clinical decision-making. The topic emphasises the necessity of a team-based approach to AI governance, encouraging students to develop strategies for interdisciplinary collaboration among clinicians, ethicists, policymakers, and technologists. This culminating section helps students integrate their understanding of ethics, risk, and safety into practical governance frameworks for AI in healthcare settings.

Objectives and competencies:

- Define AI and describe its applications in healthcare.
- Differentiate between types of AI technologies (e.g., machine learning, natural language processing, robotics) and their roles in healthcare.
- Identify the benefits of AI in clinical practice, diagnosis, and treatment.
- Assess the implications of AI for patient care, provider roles, and healthcare systems.
- Examine the inherent risks of artificial intelligence systems that could impact patient care and healthcare operation
- Discuss the societal and professional risks associated with AI in a healthcare context
- Examine the interdependencies between technical capabilities, human factors, and institutional practices in healthcare delivery.
- Identify the key ethical and legal frameworks that guide ethical decision making in relation to AI and healthcare in the EU
- Identify similarities and differences of emphasis between ethical frameworks in different healthcare professions
- Consider how ethical principles are enshrined in legislation: EU AI Act, GDPR
- Identify the sources of bias in AI
- Introduce the concept of Ethics by Design
- Assess the implications of AI bias for diversity, non-discrimination and fairness
- Consider the social and environmental impact of AI on healthcare
- Explain the importance of Explainable AI (XAI) for trust-building among patients and providers.
- Consider the implications of AI for patient consent and autonomy
- Discuss the challenges of patient privacy and data security with AI-powered healthcare tools.
- Assess the ethical considerations in AI-driven decision-making processes.
- Consider the role of human oversight in AI-assisted clinical decision-making
- Develop awareness of the vulnerabilities of AI systems that could compromise patient safety

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- Consider the importance of a team-based approach to AI governance that includes the patient voice

Intended learning outcomes:

- Define AI and differentiate between types of AI technologies used in healthcare.
- Critically evaluate the potential benefits and risks of implementing AI systems in various healthcare contexts
- Critically evaluate how the four principles of medical ethics (autonomy, beneficence, non-maleficence, and justice) apply to the implementation of artificial intelligence systems in healthcare setting
- Communicate complex concepts such as Explainable AI or algorithmic risks effectively to non-technical audiences.
- Compare EU regulatory approaches to global standards for governing ethical use of AI in healthcare.
- Assess the implications of AI bias for diversity, non-discrimination and fairness in a healthcare context.
- Assess the social, environmental, and global impacts of adopting AI technologies in healthcare settings.
- Critically analyse the role of Explainable AI (XAI) in building trust within healthcare systems and evaluate its implications for informed consent processes
- Perform an ethical assessment on an AI platform in a specific healthcare context
- Analyse data security considerations in AI-powered healthcare systems
- Develop a strategy for interdisciplinary collaboration among clinicians, ethicists, policymakers, technologists, and patients to ensure responsible use of AI.

Learning and teaching methods:

Mix of didactic teaching, case study analysis in groups, use of online resources, e.g. https://radiology.healthairegister.com/, ethical debates, reflection and project work, e.g. analysis of data sets to identify areas of possible bias.

Assessment:	Weight (in %)
MCQ	10
Individual assessment: Evaluate a hypothetical AI diagnostic tool using the Assessment List for Trustworthy Artificial Intelligence (ALTAI) and assess compliance with the EU AI Act.	40

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Group assessment: Create a short video for patients explaining concepts related to informed consent, to AI risks, and the mitigation strategies adopted by a fictional healthcare institution.	50

Lecturer's references:

High-reward, high-risk technologies? An ethical and legal account of AI development in healthcare

https://bmcmedethics.biomedcentral.com/articles/10.1186/s12910-024-01158-1

Ethics by design for artificial intelligence

https://link.springer.com/article/10.1007/s43681-023-00330-4

Ethics by Design and Ethics of Use Approaches for Artificial Intelligence

https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ethics-by-design-and-ethics-of-use-approaches-for-artificial-intelligence_he_en.pdf

Responsible AI practice and AI education are central to AI implementation: a rapid review for all medical imaging professionals in Europe

https://academic.oup.com/bjro/article/5/1/20230033/7468281

The Opportunities and Risks of Large Language Models in Mental Health

https://mental.jmir.org/2024/1/e59479/

Ethical Issues of Artificial Intelligence in Medicine and Healthcare

https://pmc.ncbi.nlm.nih.gov/articles/PMC8826344/

Biomedical Ethical Aspects Towards the Implementation of Artificial Intelligence in Medical Education

https://link.springer.com/article/10.1007/s40670-023-01815-x

The ethical issues of the application of artificial intelligence in healthcare: a systematic scoping review

https://link.springer.com/content/pdf/10.1007/s43681-021-00131-7.pdf

Mapping research strands of ethics of artificial intelligence in healthcare: A bibliometric and content analysis

https://pubmed.ncbi.nlm.nih.gov/34346319/

The EU Artificial Intelligence Act (2024): Implications for healthcare

https://www.sciencedirect.com/science/article/pii/S0168851024001623

Collective action for responsible AI in health

https://www.oecd.org/en/publications/collective-action-for-responsible-ai-in-health_f2050177-en.html

UNESCO Recommendation on the Ethics of Artificial Intelligence (2022)

https://unesdoc.unesco.org/ark:/48223/pf0000381137

Ethics guidelines for trustworthy AI

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https://digital-strategy.ec.europa.eu/en/library/ethics-guidelines-trustworthy-ai

Principles of Clinical Ethics and Their Application to Practice

https://karger.com/mpp/article/30/1/17/204816/Principles-of-Clinical-Ethics-and-Their

Evaluation of artificial intelligence clinical applications: Detailed case analyses show value of healthcare ethics approach in identifying patient care issues

https://onlinelibrary.wiley.com/doi/10.1111/bioe.12885

EU AI Act Compliance Checker

https://artificialintelligenceact.eu/assessment/eu-ai-act-compliance-checker/

The Assessment List for Trustworthy Artificial Intelligence (ALTAI) for self assessment

https://op.europa.eu/en/publication-detail/-/publication/73552fcd-f7c2-11ea-991b-01aa75ed71a1

Evaluating Dimensions of AI Transparency: A Comparative Study of Standards, Guidelines, and the EU AI Act (Academic Track)

https://drops.dagstuhl.de/entities/document/10.4230/OASIcs.SAIA.2024.10

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3 Curricula for VET in MED

The increasing integration of AI into healthcare is reshaping the roles and responsibilities of vocational healthcare professionals. To ensure that VET learners are equipped with the necessary skills to thrive in an AI-enhanced medical environment, AI2MED has developed a specialized curriculum tailored to the needs of vocational healthcare workers.

This curriculum focuses on **building foundational digital and AI literacy**, **developing practical AI collaboration skills**, and **enhancing technical competencies** for AI-driven healthcare applications. The training is designed to be hands-on and application-oriented, ensuring that learners acquire the knowledge and skills needed to work effectively with AI tools in real-world medical settings.

The curriculum comprises four key modules:

- **Basic Digital and AI Literacy** – Equipping participants with essential digital skills and the ability to navigate AI-powered healthcare systems.
- **Collaboration with AI Systems** – Providing insights into how AI tools support diagnosis, patient care, and clinical workflows, with a focus on teamwork and critical thinking.
- **Practical Technical Skills in AI Contexts** – Teaching learners how to use and optimize AI-driven medical tools while ensuring accuracy and reliability.
- **Integrated Ethical and Adaptive Competences** – Focusing on ethical considerations, AI oversight, and adaptability in an evolving digital healthcare landscape.

By implementing this curriculum, AI2MED aims to empower vocational healthcare professionals with the skills and confidence to work alongside AI, improving patient care and enhancing efficiency in medical settings. This chapter provides a comprehensive overview of the VET curriculum, detailing its structure, objectives, and learning outcomes.

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COURSE SYLLABUS	
Course title:	AI in healthcare

Study programme and level	**Study field**	**Academic year**	**Semester**
	Healthcare		

Course type	Obligatory/ Non-obligatory
University course code:	

Lectures	**Seminar**	**Tutorial**	**Clinical work**	**Other forms of study**	**Individ. work**	**ECTS**
5	5			10	10	1

Lecturer:	
Languages:	English
Tutorial:	

Prerequisits:

Basic healthcare knowledge - participants should have a foundational understanding of healthcare systems, patient care and medical workflows.

Basic digital literacy - familiarity with using computers and online resources for medical practice (such as using web browsers, managing files and folders, handling images in a digital environment)

Analytical and Problem-Solving Skills – Since AI in healthcare involves data interpretation, statistical reasoning, and ethical considerations, critical thinking is essential.

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English Proficiency - A strong command of the language is crucial for understanding lectures, reading materials, and engaging in discussions.

Content (Syllabus outline):

Module 1: Basic digital and AI literacy

This module equips the participants with both the basic necessary digital skills and the use of AI in health for data management, privacy, and automation. Participants will know how to find their way around the digital health system, collaborate with AI-powered tools, and manage patient information responsibly. Hands-on activities combined with case studies will help the participants develop relevant competencies required to work successfully in an enhanced AI healthcare environment.

Unit 1: Introduction to Digital Tools in Healthcare

This unit provides an overview of digital healthcare systems, including electronic health records (EHRs), telemedicine platforms, and AI-driven administrative tools. Participants will gain hands-on experience with basic digital platforms used in hospitals and clinics. They will also explore the concept of digital transformation in healthcare and its impact on patient care and workflow efficiency.

Unit 2: AI-Assisted Healthcare Systems

This unit introduces participants to AI applications in diagnostics, administrative processes, and patient care. They will explore how automation is used in clinical settings, such as AI scheduling assistants and digital triage tools. Participants will also examine the role of AI in enhancing medical decision-making and discuss its potential to improve efficiency and accuracy in healthcare.

Unit 3: Managing Patient Data and Privacy

This unit focuses on best practices for handling and securing patient data in AI-driven healthcare systems. Participants will learn about compliance with AI PACT and other healthcare data privacy regulations. Through case studies, they will analyse data breaches and ethical dilemmas in patient data management, developing strategies to ensure data security and patient trust.

Unit 4: Digital Literacy and AI Readiness

This unit prepares participants to critically evaluate AI-generated outputs and understand their reliability. They will explore the concepts of bias and limitations in AI tools and learn how to validate AI recommendations. Through practical exercises, participants will practise spotting misinformation and refining AI outputs to ensure they align with clinical standards.

Module 2: Collaboration with AI systems

This module explores the integration of AI in healthcare and focuses on how AI tools help with diagnosis, patient care and clinical decision making. Participants will learn how to interact with AI systems, from creating effective prompts for medical tools to using AI to improve clinical workflows. Through hands-on activities such as case studies, simulations and collaborative challenges, participants develop the ability to assess AI-generated recommendations and adapt them to improve patient care. The module emphasises critical thinking, teamwork and the responsible use of AI in healthcare.

Unit 1: AI in medical diagnostics

This unit introduces participants to the role of AI in medical diagnostics. They will learn about case studies where AI tools, such as DeepMind for retinal scans, help analyse medical images. They will also explore

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simplified AI tools for diagnosis, such as symptom checkers to simulate patient triage. A discussion on the potential of AI to increase diagnostic speed without compromising accuracy will encourage participants to think critically about its benefits and limitations.

Unit 2: Communicating with medical AI tools

In this unit, participants will practise creating effective prompts for interacting with AI tools such as ChatGPT and symptom checkers. They will simulate real-world scenarios, such as explaining lab results to a patient using AI-generated interpretations. Participants will also use AI to write a discharge summary for a patient to help them understand how to communicate medical information clearly and effectively using AI tools.

Unit 3: AI-powered clinical workflows

This unit focuses on the integration of AI into clinical workflows. Participants will work in teams to prioritise treatment in the emergency department using AI tools and synthetic patient data to simulate decision making in practise. They will also design a treatment plan for a diabetes patient using AI systems such as IBM Watson. Reflection exercises will allow participants to assess how AI helps or hinders collaboration between healthcare teams.

Unit 4: Validation and application of AI recommendations

In this unit, participants will critically evaluate AI-generated treatment recommendations by comparing them to established clinical guidelines. They will then refine these recommendations to create more accurate treatment plans, e.g. for a cardiac patient. As part of the final project, participants will present a revised AI-powered workflow for a real-world medical scenario and demonstrate their ability to use AI insights to improve patient outcomes, cross-checking AI outputs with human expertise.

Module 3: Practical technical skills in AI contexts

This module introduces participants to the practical skills for working with AI in the medical field. Participants will learn how to use medical data to train AI models and gain hands-on experience with no-code tools to analyse medical datasets. Through various activities, participants will test and improve the accuracy of AI models and optimise AI tools for clinical use, focusing on speed, precision and reliability. By the end of the module, participants will understand the importance of data quality and know how to develop, refine and apply AI tools for healthcare.

Unit 1: Medical data and AI training

In this unit, participants will explore how medical data, such as images and lab reports, are used to train AI models. Using Google Teachable Machine, they will train a skin lesion classifier with curated images and then label synthetic data from electronic health records (EHR) for AI training. Participants will engage in a discussion about the importance of data quality and its impact on the reliability and accuracy of AI tools in medicine, including real-world case studies of AI failures in medicine, such as biased models leading to misdiagnosis. This course will help participants understand the fundamental role of medical datasets in the development of AI models.

Unit 2: Creating a medical AI prototype

This unit focuses on creating AI prototypes using no-code tools. Participants will participate in a guided lab where they will create a risk predictor for heart disease using Microsoft Excel or Orange Data Mining. They will also learn about AI tools such as Zebra Medical Vision for liver disease detection and explore how such tools can be used in medical scenarios. At the end of the unit, participants will present their prototypes and discuss their potential clinical relevance. In this way, they will gain practical experience in AI development without the need for programming skills.

Unit 3: Testing AI accuracy in medicine

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In this unit, participants will test the AI models they have created in previous sessions, such as the skin lesion classifier, by bringing in new images, including those with rare conditions. They will work in groups to improve the accuracy of the model by adjusting the training parameters or adding more diverse data. Through reflection, participants will evaluate the factors that contribute to the trustworthiness of AI models in clinical settings and learn how to refine AI tools to be more reliable and effective for medical professionals.

Unit 4: Optimising AI for clinical use

The unit focuses on optimising AI tools for real-world clinical applications. Participants will explore a case study on how AI can reduce false positives in breast cancer screening and then participate in an activity where they simplify algorithms, such as decision trees, to speed up diagnostic models. For their final project, participants will design an AI tool tailored to a school clinic, such as a vaccination eligibility check, to demonstrate how AI can be optimised for practical, clinical use in a community setting.

Module 4: Integrated ethical and adaptive competences

This module develops participants' ability to critically assess AI systems in healthcare, ensuring ethical, transparent, and responsible AI integration. Participants will explore ethical considerations, human-AI collaboration, adaptive competencies, and regulatory frameworks. Through case studies, simulations, and discussions, they will learn to navigate the ethical and practical challenges of AI in healthcare.

Unit 1: Ethical Considerations in AI Healthcare

This unit examines ethical challenges in AI healthcare, such as bias, fairness, and accountability in medical decision-making. Participants will analyse case studies of AI errors and their consequences in clinical practice. They will also develop strategies for ethical AI implementation in hospitals and VET settings, ensuring that AI tools are used responsibly and transparently.

Unit 2: Human-AI Collaboration and Decision-Making

This unit focuses on the role of human oversight in AI-assisted diagnoses and treatments. Participants will learn how to evaluate the accuracy and limitations of AI tools and determine when to trust AI-generated recommendations. Through simulated ethical dilemmas, they will practise making decisions in AI-supported patient care, balancing AI insights with human judgment.

Unit 3: Adaptive Competencies for AI in Healthcare

This unit prepares participants to adapt to AI advancements and workflow changes in healthcare. They will develop communication skills for explaining AI-based decisions to patients and medical teams. Participants will also explore strategies for lifelong learning in AI-driven healthcare, ensuring they remain effective and informed professionals in a rapidly evolving field.

Unit 4: Regulatory and Policy Frameworks

This unit provides an overview of regulatory frameworks, such as the EU AI Act, and their impact on healthcare. Participants will learn about compliance with medical AI regulations and patient rights. They will also explore future trends in AI governance and ethical considerations, preparing them to navigate the evolving landscape of AI in healthcare.

Objectives and competences:

General competences

(General skills applicable to AI and healthcare)

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Understanding AI fundamentals: Explain the core concepts of AI (e.g., machine learning, neural networks) and their relevance to medicine.

Data literacy: Navigate and interpret medical datasets (e.g. patient records, imaging data) for AI applications.

Human-AI collaboration: Work effectively with AI tools to improve clinical workflows (e.g. diagnostics, patient monitoring).

Problem solving: Apply AI insights to address real-world medical challenges (e.g. treatment planning, resource allocation).

Adaptability: Adapt workflows to integrate new AI technologies while maintaining standards of patient care.

Specific competences

(Technical skills directly related to medical AI)

Use of medical AI tools: Operate AI platforms without code (e.g. Google Teachable Machine) for tasks such as classifying images (e.g. skin lesions, x-rays).

Interpret AI output: Analyse AI-generated recommendations (e.g. diagnosis predictions) for clinical relevance and accuracy.

Pre-process medical data: Clean and structure data sets (e.g. lab reports, EHRs) for training AI models.

Optimise clinical AI: Fine-tune AI tools for specific medical scenarios (e.g. prioritisation of emergencies, prediction of disease risks).

Validation of AI recommendations: Compare AI results with medical guidelines or expert knowledge.

Soft competences

(Interpersonal and transferable skills)

Critical thinking: Question and scrutinise AI results to avoid relying too much on automated systems.

Communication: Explain AI-supported findings to patients or colleagues in clear, non-technical language.

Teamwork: Collaborate with colleagues on AI-supported group tasks (e.g. creating treatment plans).

Ethical awareness: Recognise the ethical implications of AI in medicine (covered in detail in another module).

Time management: Create a balance between the integration of AI and traditional clinical tasks.

Intended learning outcomes:

Module 1: Basic digital and AI skills

- Identify key digital healthcare systems and platforms, including EHRs, telemedicine platforms and AI-driven administrative tools.
- Describe the role of AI in diagnostics, administrative tasks and patient care.
- Explain the benefits and limitations of AI-driven medical decision-making.
- Apply best practices for handling and securing patient data in compliance with GDPR and healthcare regulations.
- Critically evaluate AI-generated outputs and assess their reliability.

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Module 2: Collaboration with AI systems

- Explain how AI supports healthcare professionals in diagnosis, patient monitoring and treatment planning.
- Use basic prompting techniques to interact with AI medical tools (e.g. symptom checkers, diagnostic assistants).
- Work with AI systems to analyse patient case studies or simulate clinical workflows.
- Evaluate the accuracy and relevance of AI-generated medical recommendations.
- Customise AI-generated insights to improve treatment plans for patients.

Module 3: Practical technical skills in an AI context

- Recognise how medical data (e.g. X-rays, lab reports) train AI models.
- Use AI tools without code to analyse medical datasets (e.g. to predict disease risks).
- Test and improve AI accuracy in medical scenarios (e.g. detecting pneumonia in X-ray images).
- Optimise AI models for clinical performance (e.g. speed, precision).

Module 4: Integrated ethical and adaptive competences

- Evaluate ethical challenges in AI-driven healthcare, including bias, fairness, and accountability, and propose strategies for responsible AI implementation.
- Assess the accuracy, limitations, and risks of AI-generated medical recommendations and determine when human oversight is necessary in clinical decision-making.
- Apply ethical decision-making frameworks to real-world scenarios, balancing AI insights with human judgment in patient care.
- Explain key regulatory frameworks, such as the EU AI Act, and demonstrate compliance with medical AI regulations and patient rights.

Learning and teaching methods:

Learning methods

Case studies. Participants will analyse real medical cases to understand how AI helps with diagnoses and decision-making processes.

Practical exercises. Participants engage with AI tools such as symptom checkers or diagnostic assistants to practise interacting with medical technologies.

Role plays and simulations. In role plays, participants practise the use of AI in the clinical environment, e.g. when interpreting laboratory results or communicating with patients.

Joint project work. Participants work together to develop AI-driven solutions, such as risk predictors for heart disease or AI-assisted care plans.

Problem-based learning (PBL). Participants solve real-world problems, such as improving AI accuracy or validating AI recommendations, by adjusting training parameters or adding new data.

Discussions and reflection. Group discussions encourage participants to reflect on the ethical implications, limitations and potential risks of AI in healthcare.

Teaching methods

Direct instruction and demonstrations. Educators provide basic knowledge of AI systems and demonstrate the use of AI tools.

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Guided practise. Educators provide step-by-step instructions and guidance as participants create AI models and prototypes.

Interactive lectures and discussion sessions. Educators lead discussions to help participants understand the role of AI in healthcare.

Peer collaboration and feedback. Participants are encouraged to collaborate, share ideas and give each other feedback on their work.

Case studies and real-world scenarios. Educators present real-world healthcare case studies to illustrate how AI is used to solve complex medical challenges.

Experiments and tests. Educators guide participants through the process of testing and improving AI models, for example by evaluating the accuracy of AI in diagnosing diseases such as pneumonia or breast cancer.

Assessment:	Weight (in %)
Participation and quizzes	20
AI in healthcare use case scenario analysis and presentation	40
Final exam	40

Lecturer's references:

Mandatory readings

Nisha Talagala, Sindhu Ghanta, (2022), Fundamentals of Artificial Intelligence Volume 1 - For Middle School and High School Students, ISBN: 979-8795777597

Optional readings:

Shai Ben-David, Giuseppe Curigliano, David Koff, Barbara Alicja Jereczek-Fossa, Davide La Torre, Gabriella Pravettoni (2024), Artificial Intelligence for Medicine An Applied Reference for Methods and Applications, ISBN: 9780443136719

Thompson Stephan, (2025), Artificial Intelligence in Medicine, ISBN: 9781032438344

Manda Raz, Tam C. Nguyen, Erwin Loh (2022), Artificial Intelligence in Medicine Applications, Limitations and Future Directions, ISBN: 9811912246

Constantin Aliferis, Gyorgy J. Simon (2024), Artificial Intelligence and Machine Learning in Health Care and Medical Sciences Best Practices and Pitfalls, ISBN: 9783031393556

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4 Conclusion

The AI2MED project is at the forefront of preparing healthcare professionals for the AI-driven future of medicine. By developing comprehensive, multidisciplinary curricula for both HEI and VET learners, this deliverable provides a structured approach to equipping healthcare workers with essential AI competencies.

The proposed curricula ensure that professionals at all levels of expertise - from entry-level vocational workers to advanced HEI students - gain the theoretical knowledge and practical skills required to work effectively with AI systems. Through a combination of digital literacy training, AI collaboration exercises, technical skill-building, and ethical considerations, AI2MED promotes a well-rounded, future-proof education in AI-in-MED.

By integrating these AI-driven learning frameworks, institutions can foster a new generation of professionals who are not only AI-literate but also capable of making informed, ethical, and effective decisions in AI-supported healthcare settings. This approach strengthens Europe's position as a leader in AI-enabled medical innovation, ensuring better patient care, increased efficiency, and enhanced collaboration between AI and healthcare professionals.

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