# ABSTRACT BOOK

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# Editorial

The current Applied Medical Informatics supplement issue is focused to the 38th RoMedINF conference organized by the Romanian Society of Medical Informatics (RSMI), and dedicated this year to digitalization of healthcare. The 38th RoMedINF edition is organized as a hybrid event hosted by the University of Medicine and Pharmacy Craiova with West University of Timişoara and Politehnica University of Timişoara as co-organizers.

The 38th RoMedINF conference stands as a beacon of progress in the filed of medical informatics and digitalization of health and healthcare, with benefits and challenges. Our invited speakers will guide the audience through specific topics such as the role of medical informatics in digital health, one digital health, big data, the role of requirements and regulation of medical devices in the context of healthcare digital innovation, trends and challenges in medical image processing and how to translate research into clinical impact.

This annual international event serves as a nexus for researchers, healthcare professionals, and industry experts to converge and explore the cutting edge of health informatics and technology. The active participants, from junior researchers to experts will present specific digital solutions able to solve explicit problems. The heterogeneity of topics ensures that RoMedINF remains at the forefront of addressing the most pressing challenges and opportunities in modern healthcare. RoMedINF's multifaceted approach to knowledge dissemination, featuring keynote speeches, oral presentations, poster sessions, and demonstrations, fosters an environment of active learning and engagement.

The benefits of digitalization could be classified based on whom they affect. For healthcare systems, digitalization can reflect in costs (better monitoring and lower readmissions or early diagnosis with lower long-term costs), proactive care by real-time monitoring (e.g., wearable devices), and public health surveillance (e.g., tracking of disease spread, monitor vaccination rates etc.). Digital solutions could benefit from increased efficiency through automation (e.g., automation – appointments, administrative tasks), to identify trends and to support clinical decisions. Patients could benefit from timely access to care (see for example telemedicine) and better personal engagement supported by apps and dedicated portals. However, the challenges exist and must be considered. The high implementation costs (upfront investment and ongoing maintenance), interoperability (making systems talk the same language), data privacy and security, ethical issues in artificial intelligence assisted healthcare, resistance to change and the divide (e.g., access inequalities and tech fatigue) remain the main issues of digitalization in medicine.

The 38th RoMedINF abstracts cover specific topics, such as applications of artificial intelligence in pattern recognition, classification and medical image processing and interpretation, one digital health, medical device regulations, digital literacy evaluation, automated handwriting recognition, HealthTech startups, implementation of technologies in healthcare daily workflow, ethics of artificial intelligence assisted medicine, communication technologies in medicine, biostatistics, bioinformatics, healthcare management, deep learning applications in medicine, technology and disease monitoring.

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# The Digital Future of WHO Classifications

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## Abstract
WHO maintains classifications that are crucial for the functioning of the healthcare systems worldwide, namely ICD (International Classification of Diseases), ICF (International Classification of Functioning, Disability and Health) and the upcoming ICHI (International Classification of Health Interventions).
The traditional way of making classifications available to their audience was based on printed books, which in turn shaped their usage in health information systems. However, in the recent years and specifically with the development of ICD 11th Revision (ICD-11), a shift towards full integration with computerized systems has been designed and implemented. So, nowadays the official distribution of ICD-11 is no more based on a 3 books set, but on a computerized platform that includes an API, a Javascript toolkit for embedding classifications in health information systems, a browser for navigating the classification and other tools, all oriented towards multilinguality and openness. Furthermore, the architecture of ICD-11 itself is more modern and includes a foundation layer on which the proper Mortality and Morbidity Statistics Classification is built upon. Since the last year, the same technological approach has been extended to the other two classifications, which now share the same platform and approach. This talk will explore the approach and novelties that characterize the digital path undertaken by WHO for its classifications, and its impact on future digital systems.

**Keywords:** International Classification of Diseases (ICD); Digital Systems; Healthcare Systems.

# Graph Neural Networks for Digital Pathology

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## Abstract
Graph Neural Networks (GNNs), introduced in 2017, are a category of deep learning models specially designed to handle graph-structured data, allowing them to capture the intricate relationships and dependencies within complex data structures. The graph learning tasks can be either node-level, edge-level or graph-level. GNNs are well-suited for analyzing data such as social networks, molecular structures, and medical images, capturing both local and global patterns. The complexity and high dimensionality of medical images make them suitable for analysis using GNNs, which can leverage the relationships between elements in the data, offering a more complex and complete analysis that can improve both the accuracy and efficiency of medical image processing tasks such as classification, segmentation, and detection of abnormalities. This presentation will provide a summary of a systematic review we carried out to identify medical imaging areas where GNNs have been applied, with focus on their applications in histopathology.

**Keywords:** Graph Neural Networks (GNNs); Medical Imaging Processing; Digital Pathology.

# Advancing Global Digital Healthcare Innovation through One Digital Health and Multilingual Ontologies

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## Abstract
The digital transformation of healthcare offers significant opportunities alongside complex challenges. One Digital Health (ODH) provides a unified framework integrating artificial intelligence, data science, and healthcare informatics to enhance decision-making, interoperability, and sustainability within health ecosystems. By connecting human, animal, and environmental health, ODH addresses the critical need for cross-sector collaboration, breaking down traditional silos to improve health outcomes. This presentation delves into the benefits of digitalization in healthcare, such as enhanced data accessibility, personalized medicine, and real-time epidemiological monitoring. It examines the role of AI-driven analytics, process mining, and digital epidemiology in optimizing personalized patient care, public health strategies, and emergency response systems. Moreover, the presentation emphasizes key challenges like international communication and multilingual issues through the Medical Informatics and Digital Health Multilingual Ontology (MIMO), which facilitates interactions within a global community. By adhering to the FAIR (Findable, Accessible, Interoperable, Reusable) principles, both ODH and MIMO promote responsible digital health practices that encourage transparency and citizen and professional engagement while also supporting the sustainability of medical technology. Ultimately, ODH presents a roadmap for a more integrated, ethical, and sustainable future in digital health. It balances technological innovation with responsible governance to maximize benefits and mitigate risks. The presentation concludes with strategic recommendations for fostering a global, interdisciplinary approach to digital healthcare innovation.

**Keywords:** One Health; Digital Health; One Digital Health; Biomedical Ontologies; Intersectoral Collaboration.

# Big Data for Veterinary Sciences: Instructions for Use

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## Abstract
The integration of Big Data into veterinary sciences is revolutionizing animal health management, providing advanced tools for disease surveillance, treatment optimization, and welfare assessment. This transformation aligns with the broader One Digital Health paradigm, which emphasizes the interconnectedness of human, animal, and environmental health. As veterinary data become increasingly complex, leveraging informatics-driven approaches is essential to enhance decision-making and ensure sustainable animal care practices. This presentation explores two key research areas: veterinary medical informatics and precision livestock farming, each supported by real-world case studies. In the context of pet care, the use of electronic medical records (EMRs) combined ML models facilitates early disease detection, improves diagnostics, and enables personalized treatment strategies. By harnessing structured data, veterinary professionals can refine medical protocols, leading to better patient outcomes. In livestock management, the integration of smart cameras and artificial intelligence supports real-time health monitoring and predictive analytics, helping farmers detect early signs of disease, optimize resource allocation, and improve production efficiency. These data-driven innovations contribute to precision livestock farming, promoting animal welfare while enhancing food security and sustainability. By merging AI-related techniques, sensor-based monitoring, and advanced analytics, Big Data is shaping the future of veterinary sciences. This data-centric approach not only strengthens veterinary practice but also reinforces One Digital Health, ensuring a holistic and evidence-based strategy for managing animal health in a rapidly evolving digital ecosystem.

**Keywords:** Veterinary Medical Informatics; Precision Livestock Farming; Big Data; Digital transformation; One Digital Health.

# What is the Role of Medical Informatics in Digital Healthcare?

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## Abstract

Medical Informatics plays a fundamental role in modern Digital Healthcare, serving as a bridge between clinical practice, data science, and information technology. It facilitates the efficient collection, storage, retrieval, and application of health data, ultimately improving patient outcomes, reducing costs, and enhancing the healthcare experience.

Our expertise spans key areas of Medical Informatics, including:

(i) Biological Signal Processing – Collecting and analyzing physiological data.
(ii) Medical Instrumentation Integration – Seamlessly incorporating medical devices into healthcare workflows.
(iii) Data Management & Interoperability – Ensuring smooth integration and accessibility of health records.
(iv) Electronic Health Records (EHRs/EMRs) – Developing structured, shareable, and standardized patient records using frameworks like HL7 and FHIR.
(v) Clinical Decision Support Systems (CDSS) – Leveraging AI and machine learning to assist clinicians with diagnostics, treatment planning, and alerting for drug interactions or abnormal test results.
(vi) Telemedicine & Remote Monitoring – Supporting virtual consultations, real-time health tracking via IoT and wearables, and home-based chronic disease management.
(vii) Big Data & Predictive Analytics – Analyzing large datasets to identify disease patterns, optimize hospital efficiency, and advance personalized medicine through risk stratification and predictive modeling.
(viii) Cybersecurity & Privacy in Healthcare – Implementing robust security solutions (e.g., encryption, blockchain) to safeguard sensitive patient data and ensure compliance with regulations like HIPAA (USA), GDPR (EU), and local healthcare laws.
(ix) AI & Automation in Medical Workflows – Utilizing NLP (Natural Language Processing) to extract insights from medical literature and clinical notes while automating administrative processes such as billing and scheduling.
(x) Medical Education & Knowledge Assessment – Enhancing training programs with digital tools and assessment frameworks.

Alongside advancing these areas, we also highlight the historical evolution of Medical Informatics, particularly in Romania. The Faculty of Medicine in Craiova pioneered the country's first official Medical Informatics course in February 1991, marking a significant milestone in medical education. This achievement was the result of many years of dedicated work by Prof. Mihai Tarata and Prof. Valeriu Nestianu, who had been developing medical electronic instrumentation since 1974.

Key contributions included:

- 1978 – Development of a method and device for quantitative electromyographic analysis (OSIM Patent 70610) – with this we initiated digital electromyography in Romania.

- 1981 – Research on fuzzy sets for automated diagnostic approximation (National Symposium on Functional Analysis and Applications, Craiova).
- 1985-1987 – Creation of a non-invasive system for recording late electrocardiographic and His potentials, making our lab the 7th in the world to achieve this noninvasively, in real-time.
- 1995 – The first implementation in Romania of a self-made, secure, automated, computerized multiple-choice examination system, allowing for same-day publication of results without errors.

Following the launch in 1991 of Medical Informatics as an academic mandatory discipline in Craiova, other medical schools in Romania quickly adopted similar programs. On January 24, 1992, we hosted the first National Meeting of Medical Informatics representatives from all Romanian medical universities, leading to the nationwide adoption of our curriculum. Through continuous innovation and integration, Medical Informatics remains a cornerstone of digital transformation in healthcare, shaping the future of medical practice and patient care.

**Keywords:** Medical Informatics; Fundamental Role; Digital Healthcare.

# Virtual Reality Technologies Supporting Medical Education

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## Abstract
Integrating new technologies in current practice marks an important step in medical education. The main benefit is that future physicians may improve their skills in a safe environment and consequently for the future, improve the patient care outcomes. Using Virtual Reality, the training of the medical learners is done without any risk for the patient. The paper will describe the VR/ER technologies for the medical domain and different scenarios will be presented for the medical students or for the professionals involved in continuing education to gain better skills in digital health. Will discuss how Artificial Intelligence can personalize the trainees' experiences by adjusting the content and the difficulty of the activity based on their experience. A summary of support new technologies will be presented with examples in medical training. For enhanced training and skill development VR provides realistic, risk-free environments for practicing complex procedures, improving surgical skills, and enhancing diagnostic abilities. It allows for repeated practice of rare or challenging scenarios, leading to increased confidence and competence. Virtual Reality can provide detailed, real-time feedback, allowing for immediate correction and improvement.

**Keywords:** Virtual Reality (VR); Technologies; Medical Education; Training; Artificial Intelligence.

# Harnessing and Misapplying Artificial Intelligence in Medical Evidence Search

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## Abstract
The 6S pyramid, a conceptual model that systematically categorizes evidence-based resources according to their type, to facilitate rapid and efficient clinical decision-making, is a cornerstone of evidence-based practice. Two main area can be seen in the 6S pyramid with the original studies evidence at the bottom of pyramid and five classes of summaries of evidence (pre-appraisal secondary sources) at the top (Systems, *Computerised Decision Support Systems* – Summaries, *Clinical practice guidelines* – Synopsis of Synthesis, *summarises findings from high quality systematic reviews* – Synthesis, *systematic review* - Synopsis of Studies, *critically appraised brief summaries of original studies*) [1]. Artificial intelligence (AI) has emerged as a transformative agent in the retrieval of medical evidence, offering both benefits and pitfalls. Artificial intelligence-driven information retrieval tools offer timely access to information, but misapplication can lead to biased or erroneous retrieval outcomes (for example, biased AI-recommendations in an image-based diagnosis simulation experiment [2]). Considering the amount of evidence that is published yearly in medical scientific literature, AI-tools could be useful in searching and retrieving medical evidence. Healthcare professionals access evidence summaries through dedicated professional platforms such as ClinicalKey, UpToDate, and guidelines (e.g., NICE, NHMRC Clinical Practice Guidelines Portal, National Clinical Guidelines Clearinghouse, etc.). Dedicated AI-assisted search platforms have been developed to support rapid access to medical evidence. Some examples of such platforms are OpenEvidence and EvidenceHunt. OpenEvidence (https://www.openevidence.com/) is platform develope "*to aggregate, synthesize, and visualize clinically relevant evidence in understandable, accessible formats that can be used to make more evidenced-based decisions and improve patient outcomes*". OpenScience signed a content agreement with *The New England Journal of Medicine*, a highly prestigious, often ranked at or near the top regarding imapact factor and influence. EvidenceHunt (https://evidencehunt.com) is an AI-powered search engine able to streamline clinical evidence searches that allow users to customizable e-alerts on the topic of interest. In this presentation, simulations based on case vignettes are presented to highlight potential and challenges of AI-driven retrieval of medical evidence compared to traditional access to medical evidence.

**Keywords:** Evidence-Based Medicine; Accuracy; Artificial Intelligence; Conversational Tool.

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# Mapping the HealthTech Landscape in Moldova: Challenges, Opportunities, and a Roadmap for Digital Health Innovation

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## Abstract

*Background:* The digital health ecosystem in Moldova is evolving rapidly, with HealthTech startups emerging to address healthcare challenges and align with global digital health trends. Despite these developments, the sector faces barriers such as limited infrastructure, regulatory gaps, and insufficient investment. Understanding the current landscape of HealthTech startups is essential to identify challenges, explore opportunities, and guide stakeholders in strengthening Moldova's digital health ecosystem. *Aim:* This paper aimed to analyze the current landscape of HealthTech startups in Moldova by identifying key players, mapping existing regulations, and outlining the challenges and opportunities for growth. The objective is to provide clear, actionable insights to policymakers, investors, and entrepreneurs to support the development of Moldova's digital health ecosystem. *Materials and Methods:* This study was conducted between January 2024 and January 2025, based on an analysis of relevant reports, industry insights, and discussions from digital health events and forums held in Moldova. Sources included national policies, international frameworks, and industry reports addressing digital health and HealthTech developments. Reports and events focused on HealthTech in Moldova during the past five years were included, while non-health-related documents and unrelated events were excluded. The analysis aimed to provide a comprehensive and replicable overview of Moldova's HealthTech landscape. *Results:* Moldova's HealthTech sector is in an early yet dynamic stage, with a growing number of initiatives shaping the ecosystem. The study identified 10 active startups, three accelerators, and several collaborative initiatives focused on digital health innovation. These startups operate in areas such as telemedicine, patient data management, and digital diagnostics. Despite this momentum, challenges persist, including regulatory gaps, limited funding opportunities, and insufficient digital infrastructure. However, increasing stakeholder engagement, the establishment of support programs, and the development of national digital health strategies indicate promising opportunities for further growth and innovation. *Conclusion:* Moldova's HealthTech sector has growth potential but faces challenges in regulation, funding, and infrastructure. Strengthening the ecosystem requires clear policies, increased investment, and support for startups and digital literacy.

**Keywords:** HealthTech Startups; Digital Health; Healthcare Innovation.

# Artificial-Intelligence-Based Automatic Analysis of Urothelial Carcinomas – Our Experience

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## Abstract

Diagnosing urothelial carcinoma (UC) is usually a quite simple task but requires thoroughly examination of several slides; cases with more than 10 slides are not uncommon. Thus, an automated method for histopathological analysis is more than welcome. We selected from our archives 105 patients (100 UC and 5 cystitis); we examined the slides and selected and scanned one slide/case, obtaining whole slide images (WSIs). We performed a pixel-per-pixel semantic segmentation of 21 selected areas/WSI for several classes (high-/low-grade tumor, invasion, emboli, stroma, vessels, smooth muscle, etc.). We trained an InternImage model on this data set; we used dice coefficient (DCC) and intersection-over-union (IoU) as metrics for our model performance. UC patients were predominantly males (72%), average age 66.04years, 46% low-grade UC/ 54% high-grade UC, 42% noninvasive/ 58% invasive (28%pT1 and 30%pT2 or above). There were, on average, 3.93 paraffin blocks/case (1-17 paraffin blocks/case). The data set obtained after annotation was arbitrarily separated in training (57.18%), validation (21.37%) and test sets (21.44%). The results on test set are: high-grade tumor (0.66 DCC/0.49 IoU), low-grade tumors (0.82 DCC/0.70 IoU), stroma (0.84 DCC/0.73 IoU), vessels (0.75 DCC/0.60 IoU) and LVI (0.77 DCC/0.62 IoU). We evaluated each patch of the test set; apparently low DCC and IoU scores are consequences of human inability in precise drawing of the classes and/or impossibility of annotation of very small vessels. Our model identifies high-/low-grade tumor, invasion, emboli, and smooth muscle and highlights them on a heat map. The pathologist analyses highlighted areas, thus shortening the time required by microscopic analysis. The results of our model are encouraging; its use improves the diagnostic accuracy, reduces the time taken for analysis, and potentially leads to better patient outcomes.

**Keywords:** Artificial Intelligence; Urothelial Carcinoma; Tumor Grade; Invasion.

**Funding**: This research was partially funded by a grant of Ministry of Research, Innovation and Digitization, CNCS–UEFISCDI, project number PN-III-P4-PCE-2021-0546 (PCE 109/2022).

# NeuroFuzzXAI: A Hybrid Artificial Intelligence Framework for Epileptic Seizure Detection

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## Abstract

*Background and Aim:* Detecting epileptic seizures from electroencephalogram (EEG) recordings is crucial for accurate diagnosis and treatment. While deep learning models achieve strong predictive performance, their black-box nature limits clinical applicability. This study proposes a hybrid framework that combines explainable artificial intelligence (XAI) with fuzzy logic to improve both accuracy and interpretability in seizure classification. The objective is to enhance transparency in decision-making by identifying key EEG features and providing an interpretable risk assessment. *Materials and Methods:* This study utilizes the publicly available Epileptic Seizure Recognition dataset [i], which consists of EEG recordings from 500 subjects, segmented into 11,500 one-second windows, each described by 178 features. The dataset is balanced, comprising five equally distributed classes that capture a diverse range of brain activity patterns, including pathological conditions as well as natural variations in EEG signals. The classification labels were manually assigned by neurologists, serving as the gold standard diagnostic for seizure detection and ensuring that predictions align with clinically validated seizure patterns. A deep learning model was implemented in PyTorch, trained with cross-entropy loss and optimized using Adam. Instead of using all 178 features, SHapley Additive exPlanations (SHAP) identified the three most influential EEG features, which were then processed through a fuzzy inference system that assigns seizure risk as Low, Medium, or High. This hybrid approach enhances interpretability while maintaining predictive accuracy, reducing computational complexity, and mitigating overfitting. *Results:* Compared to a standard deep learning model utilizing all features, our hybrid approach improved classification performance by 12%. The deep learning component alone achieved a high classification accuracy, but integrating fuzzy logic refined decision boundaries and enhanced interpretability. SHAP analysis highlighted key EEG features contributing to predictions, increasing model transparency. The fuzzy inference system generated clinically meaningful risk assessments that closely aligned with deep learning outputs, providing an intuitive representation of seizure likelihood. *Conclusion:* The proposed hybrid framework successfully integrates deep learning with explainable fuzzy logic, addressing both performance and interpretability challenges in seizure detection. By bridging artificial intelligence-based classification with human-intuitive decision-making, this approach holds promise for clinical applications. Future work will focus on real-time deployment in healthcare settings to support epilepsy diagnosis and monitoring.

**Keywords**: Epileptic Seizure Detection; Explainable Artificial Intelligence (XAI); Fuzzy Logic System; Electroencephalogram (EEG) Analysis; Hybrid Deep Learning Model.

[i] Dataset source: https://www.kaggle.com/datasets/harunshimanto/epileptic-seizure-recognition

# Electroencephalography Signal Analysis: Classification Techniques and Applications

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**Abstract**
Electroencephalography (EEG) signal analysis has become a crucial tool in neuroscience, biomedical engineering, and brain-computer interfaces (BCI) applications. This study explored EEG signal processing and classification techniques, focusing on applications driven by visual stimuli. The main focus of the study is the use of visually evoked potentials (VEPs) and steady-state visual evoked potentials (SSVEPs), which are widely used in BCI applications. Several signal acquisition and preprocessing techniques were investigated, including artifact removal, feature extraction methods, such as wavelet transforms and common spatial patterns, combined with classification approaches like support vector machines (SVM), and signal enhancement methods. The impact of stimulus type, frequency, and presentation techniques on EEG signal quality and classification accuracy was also analyzed. The primary application included a P300 speller for hands-free text input, a browser plugin enabling seamless web navigation via brain signals, and a desktop control system for interacting with operating systems and software. These applications demonstrate the usefulness of BCIs in day-to-day life, using only visual stimuli, such as flashing images and other visual queues as a means of communicating with the computer. The ultimate goal is to offer assistive solutions for people with disabilities and push the boundaries of non-invasive neurotechnology in everyday life.

**Keywords:** Electroencephalography (EEG); Signal Processing; Brain-Computer Interface (BCI); Support Vector Machines (SVM); P300 Speller; Assistive Technology.

# Comparative Analysis of Facial Expression Recognition Methods

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## Abstract
This paper aimed to investigate human emotion recognition through the analysis of facial expressions, using both classical machine learning methods and advanced techniques based on deep neural networks. The research compares the performance of classical machine learning algorithms (such as K-Nearest Neighbors, Gaussian Naive Bayes, Support Vector Machines, Adaptive Boosting, Decision Tree, and Random Forest) with the modern deep learning methods (such as Convolutional Neural Networks, Deep Neural Networks, and Recursive Neural Networks) using standardized datasets. The main steps include image preprocessing, noise reduction from the data by removing the background, and extracting essential features for the classification of basic emotions according to Paul Ekman's model, which defines the set of universal emotions (happiness, anger, surprise, sadness, disgust, fear). Performance evaluation is based on metrics such as accuracy, precision, and F1 score, using validation methods like hold-out and K-fold cross-validation. Emotion recognition through facial expression analysis holds significant importance in various fields, including the medical domain, where it is used for the early detection of affective disorders, monitoring the emotional state of patients, and improving human-machine interaction in Artificial Intelligence-assisted therapies. The integration of such solutions can contribute to the development of decision support systems in psychiatry, optimizing therapeutic strategies, and improving the quality of care for patients with neuropsychological conditions. The research not only deepens the understanding of emotion classification algorithms but also provides valuable perspectives for their application in crucial areas such as mental health and personalized medical assistance.

**Keywords:** Emotion Recognition; Facial Expression Analysis; Machine Learning; Deep Learning Mental Health.

# Patient-Clinic Communication App

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## Abstract
The Patient-Clinic Communication App aims to improve communication between patients and healthcare facilities. Its primary purpose is to enable patients to manage their health easily and conveniently from anywhere. However, currently, patients are facing challenges such as long waiting times while trying to schedule an appointment, limited access to non-digital health records and difficulties in maintaining a good communication with their doctor. The app covers functionalities such as scheduling appointments and aiding in diagnosis. It allows patients to easily access their reports like receipts, scans and medical documents. Besides these, some other key features that are implemented inside the application consist of emergency report capabilities, connection with labs for medical testing, meetings and notifications. Both patients and doctors can create accounts to connect through the application, facilitating communication and access to essential features. Users can communicate through the built-in chat feature or by joining a pre-scheduled virtual appointment. In order to ensure data confidentiality, the information about the user is visible only to their contacts, while the medical files can be seen only by the user and their doctors. The application is built using React Native for the frontend, which simplifies the development of different mobile operating systems, Node.js for the backend and a FireBase database to store the data.

**Keywords:** Medical Communication; Technology Assisted Communication; Mobile Application.

# A Comparison Between Artificial Intelligence and Radiologists' Ability to Detect Lung Nodules

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## Abstract

*Background*: Early and accurate identification of pulmonary nodules as potential indicators of lung cancer is essential to reducing lung cancer-related mortality and morbidity. Artificial intelligence (AI) holds promise for improving diagnostic precision and specificity in lung cancer detection. The aim of this study is to emphasize this information. *Methods*: Contrast-enhanced chest CT scans from 224 patients aged 40 to 75 were analyzed retrospective to compare pulmonary nodule detection rates across three approaches: AI-assisted reading, non-AI-assisted reading, and AI-generated standalone reports. Patients who had a history of lung surgery, incomplete diagnostic report or major respiratory CT artifacts were excluded from the study. *Results*: Radiologists assisted by AI missed significantly fewer nodules ($p = 0.049$) and demonstrated an almost perfect correlation (0.999) with expert reference values, reducing the mean absolute error (MAE) from 12.24 to 4.92. Artificial Intelligence also improved detection sensitivity from 80% to 99% and significantly lowered false negatives from 938 to 34, enhancing both diagnostic accuracy and efficiency. *Conclusions*: Artificial Intelligence-assisted reading has proven superior to unaided radiologist evaluation in detecting lung nodules. These findings support the potential of AI-powered systems as valuable tools in clinical practice, complementing radiologists' expertise. Integrating AI into lung cancer screening may lead to more effective detection strategies and encourage broader adoption of AI in diagnostic workflows.

**Keywords:** Lung cancer; Artificial Intelligence (AI); Computed Tomography (CT); Lung Nodule.

# Enhancing Patient-Medical Staff Interaction using Technology

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## Abstract
In the context of digitalization in the healthcare sector, effective communication between patients and clinics is essential to improve the quality of medical services. This paper proposed the development of a web application aimed at facilitating interactions between patients and medical staff through an accessible, secure, and user-friendly platform. The application provides essential functionalities, such as appointment scheduling, automated notifications, management of the patient's medical history, and a real-time communication system between users. In addition, the solution integrates a secure authentication module, ensuring the protection of personal and medical data. We analyzed first the existing market solutions to identify their limitations and justify the need for such an application. A client-server architecture is proposed, based on web technologies, including frontend and backend frameworks and scalable databases. Furthermore, a detailed work plan was outlined, covering the stages of development, testing, and implementation. The anticipated results include improving patients' access to medical services, optimizing clinic workflows, and creating a more efficient user experience. Our study highlights the potential of the proposed solution to contribute to the digitalization of healthcare services and increase user satisfaction.

**Keywords:** Communication; Web Application; Vue.js; Spring Boot; JWT; Postman; PostgreSQL.

# Enhancing Fetal Anomaly Scans with Artificial Intelligence: Advances, Applications, and Challenges

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## Abstract
The fetal anomaly scan is a critical imaging evaluation during pregnancy, essential for detecting structural abnormalities. However, its accuracy is often compromised by factors such as high fetal mobility, maternal obesity, inter-observer variability, and protocol limitations. The integration of artificial intelligence (AI) into fetal ultrasound imaging holds the potential to mitigate these challenges by improving visualization, reducing examination time, and enhancing diagnostic precision. Artificial intelligence has been successfully applied to automate standard plane detection, biometric measurements, and, to a lesser extent, the identification of fetal malformations. To further advance the field, the PARADISE project has developed a comprehensive public dataset of 2D ultrasound scans capturing fetal morphology across various imaging planes, including organ segmentation (available at https://zenodo.org/records/14093338). This talk explores the current and emerging applications of AI in prenatal diagnosis, focusing on its role in optimizing ultrasound imaging and addressing key challenges in clinical implementation.

**Keywords:** Fetal Anomaly; Imaging Planes; Organ Segmentation; Artificial Intelligence (AI).

# Artificial Intelligence in Radiology and Medical Imaging in Romania: Current Applications and Future Perspectives

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## Abstract
*Background and Aim:* Artificial intelligence (AI) has become an essential tool in radiology, improving diagnostic accuracy and efficiency. In Romania, AI is increasingly used in medical imaging, with advancements in lung nodule detection and monitoring, neuroimaging for early diagnosis of neurodegenerative diseases, and prostate cancer assessment. This review explored the impact of AI in these areas and its role in enhancing radiological workflows. *Material and Methods:* A literature review was conducted, analyzing scientific studies, clinical reports, and publicly available data on AI applications in Romanian radiology. The review focused on AI-driven improvements in image analysis and lesion detection, highlighting their potential benefits and challenges. *Results:* Artificial intelligence has significantly contributed to early disease detection and diagnosis. In lung imaging, deep learning algorithms have improved the identification and segmentation of pulmonary nodules, aiding in early lung cancer detection. In neuroimaging, AI-powered analysis has enhanced the identification of brain atrophy patterns, supporting the diagnosis of neurodegenerative diseases. In prostate imaging, AI has improved lesion characterization and Prostate Imaging-Reporting and Data System (PI-RADS) scoring, leading to more precise prostate cancer assessments. Despite these advancements, challenges such as algorithmic biases, false positives, and variability in AI performance remain areas of concern. *Conclusions:* Artificial intelligence integration into Romanian radiology is advancing, with significant improvements in disease detection and diagnostic accuracy. These technologies support radiologists by refining image interpretation and enhancing efficiency. However, further research, validation, and regulatory oversight are needed for broader clinical adoption and increased reliability.

**Keywords:** Artificial Intelligence (AI); Radiology; Medical Imaging; Lung Cancer Detection; Neuroimaging; Prostate Cancer.

# AI-Assisted MRI Analysis for Multiple Sclerosis: Lesion Detection and Brain Atrophy Assessment

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## Abstract

*Introduction:* Multiple sclerosis (MS) is a chronic autoimmune disorder that leads to neurodegeneration and progressive neurological impairment. A key imaging feature of MS is the presence of demyelinating brain lesions, which vary in distribution and size. This study aimed to assess the performance and clinical relevance of AI-based MRI analysis for lesion detection and brain atrophy quantification in patients with MS. *Methods:* Patients diagnosed with MS who underwent magnetic resonance imaging (MRI) brain scans at the Medical Imaging Department of the University of Medicine and Pharmacy in Craiova were included. There were no exclusion criteria. Seventy patients (42 women, 28 men) diagnosed with MS underwent MRI examinations between 2021 and 2023 using a Philips Ingenia 3T MRI system. The artificial intelligence (AI) software mdbrain (Mediaire) was utilized for automated lesion detection and volumetric analysis, requiring sagittal T1 3D and axial FLAIR sequences. *Results:* Brain volume reduction was identified in 56 of the 70 patients (80%), predominantly in the frontal and parietal lobes. Atrophy was assessed relative to age- and sex-matched normative data generated by the software from healthy controls. The AI software detected 3,120 demyelinating lesions: 2,050 in deep white matter, 596 periventricular, 310 juxtacortical, and 164 infratentorial. Patients were grouped by age as follows: 21–30 years (14), 31–40 years (18), 41–50 years (24), and >50 years (14). Most changes were observed in patients aged 31–50 years (42 patients, 60%). *Conclusions:* These findings highlight the potential of AI-assisted MRI in identifying MS-related structural brain changes. By enabling reproducible lesion mapping and age-adjusted atrophy analysis, such tools may support improved disease monitoring and personalized care. A direct comparison with conventional radiological assessment was not performed and remains a relevant direction for future research.

**Keywords:** Multiple Sclerosis; Brain Atrophy; Artificial Intelligence (AI); Magnetic Resonance Imaging (MRI).

# Federated Learning for COVID-19 Detection: Artificial Intelligence-Assisted Diagnosis from Unsegmented Chest Computed Tomography Scans

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## Abstract

*Background and Aim:* Coronavirus Disease (COVID-19), caused by the Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus, is a highly infectious disease that has had a profound global impact. Reverse transcription polymerase chain reaction (RT-PCR) remains the gold standard for SARS-CoV-2 detection; however, chest computed tomography (CT) imaging plays a crucial role in identifying COVID-19-related lung abnormalities, particularly when RT-PCR results are negative or inconclusive. In Romania, the first officially recorded COVID-19 case was reported on February 26, 2020. *Material and Methods:* In this study, we developed a federated learning (FL) framework utilizing pre-trained deep learning models to detect COVID-19 from unsegmented chest CT images. We compiled a dataset of 2,230 axial chest CT images in lung window settings, categorized into three groups: COVID-19 (1,016 images), lung cancer and non-COVID-19 lung infections (610 images), and normal lung appearances (604 images). The COVID-19 images were sourced from our institution's picture archiving and communication system (PACS) and reputable public databases, including Radiopaedia, Radiology Assistant, Harvard Dataverse, and the COVID-19 common pneumonia chest CT dataset. Three clients, each with distinct datasets, participated in the FL process, enabling collaborative model training without direct data sharing. *Results:* The FL approach demonstrated promising results in classifying COVID-19 from unsegmented chest CT images. The centralized VGG-16 model achieved a training categorical accuracy of 93.90% and a validation accuracy of 79.00%. The proposed FL VGG-16 model attained a training categorical accuracy of 83.82% and a validation accuracy of 79.32%. *Conclusions:* These findings suggest that FL can effectively facilitate collaborative model development across institutions while preserving data privacy, offering a viable adjunct diagnostic tool to enhance COVID-19 detection and patient management.

**Keywords:** Federated Learning (FL); Coronavirus Disease (COVID-19); Computed Tomography (CT); Artificial Intelligence-Assisted Diagnostics; Early Detection.

# Evaluating the Effectiveness of Artificial Intelligence in Prostate Cancer Detection using Biparametric Magnetic Resonance Imaging: A Comparative Study

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## Abstract

*Background and Aim:* Prostate cancer is a leading cause of cancer-related mortality among men worldwide. Biparametric magnetic resonance imaging (bpMRI) plays a crucial role in early detection and evaluation of prostate lesions. Artificial intelligence (AI) has emerged as a promising tool for optimizing diagnostic workflows. This study aimed to assess the effectiveness of the commercial AI software Mediaire© in identifying suspicious prostate lesions on bpMRI, comparing its performance with interpretations by experienced radiologists and evaluating its potential to enhance early prostate cancer detection through concordance with human evaluations. *Materials and Methods:* A retrospective analysis was conducted on prostate bpMRI scans performed at the Imaging Center of the University of Medicine and Pharmacy Craiova between January 2024 and February 2025. The study included 181 bpMRI scans from patients who presented for diagnostic evaluation rather than post-treatment monitoring. The AI software Mediaire analyzed the scans, and its findings were compared to the independent assessments of two radiologists specializing in prostate imaging. *Results:* Of the 181 bpMRI scans analyzed, Mediaire's AI accurately identified prostate lesions in 132 cases (73%). The software proved beneficial in 94 cases (52%) by reducing lesion identification time by 10-15% and prompted a reassessment of initial diagnoses in seven cases (4%). Among the 49 errors recorded by Mediaire's AI, 57% occurred in the transitional zone and 43% in the peripheral zone. Error distribution included 36% false-negative findings, 21% false-positive findings, 20% PI-RADS (Prostate Imaging-Reporting and Data System) overestimations, and 23% PI-RADS underestimations. *Conclusion:* Integrating AI into radiological evaluations demonstrated its potential to streamline prostate lesion identification and reduce diagnostic time. Although AI showed encouraging results in lesion detection, further refinements are necessary to enhance its accuracy, particularly in specific prostate zones. The study highlights AI's role as a supportive tool, complementing the expertise of radiologists. *Limitations:* The study's main limitation was the exclusion of contrast-enhanced images due to Mediaire's software constraints, which may affect the broader applicability of the results. Contrast enhancement can improve risk stratification in a limited percentage of cases compared to non-contrast examinations. Further software refinements could enhance PI-RADS scoring, but contrast enhancement remains an important factor in certain diagnostic scenarios.

**Keywords:** Prostate Cancer; **bip**arametric Magnetic Resonance Imaging (bpMRI); Artificial Intelligence (AI); PI-RADS.

# Impact of Implementation of DICOM Modality Worklist on Patient Registration at the Diagnostic Radiology Department: A One Center Retrospective Study

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## Abstract
*Background*: Nodaway most hospitals in Egypt have digital radio-diagnostic modalities that support the DICOM protocol. Integrating radiology information systems with medical imaging equipment has numerous benefits, including improved efficiency, reduced errors, enhanced patient experience, accelerated workflow for healthcare workers, and improved resource management. The results of the implementation of the DICOM modality worklist system at the diagnostic radiology department of Minia Oncology Center underscore the value of such systems in healthcare settings, providing clear evidence of enhanced operational performance and patient care quality. *Methods*: The study included 500 patients, five registration staff, and 10 radiology technicians. The included radiological modalities in this survey are MRI, CT, and mammography. Data was collected through surveys, interviews, and direct observation. Pre-implementation data were gathered for two months, followed by a one-month implementation period, and post-implementation data were collected for another two months. *Results*: The overall results of this study demonstrate significant improvements in several key areas following the implementation of the DICOM modality worklist system at the diagnostic radiology department of Minia Oncology Center. *Conclusion*: The implementation of the DICOM modality worklist system at the Minia Oncology Center has proven effective in enhancing patient registration efficiency, reducing errors, and improving both patient and staff satisfaction. The integration of HIS-RIS-PACS systems, facilitated by the DICOM protocol, is crucial for any hospital seeking to improve operational performance and patient care quality. The significant improvements observed in this study highlight the indispensable role of DICOM in modern medical imaging and patient management systems.

**Keywords:** DICOM; Worklist; Integration; Radiology Information System (RIS).

## Introduction

To the best of our knowledge, this study is the first of its kind to be conducted within the Egyptian healthcare landscape, aiming to evaluate the transformative effects of the DICOM Modality Worklist system in a diagnostic setting specifically in the Minia Oncology Center. The application of information technology in healthcare has been relatively slow compared to other fields such as banking, transportation, and trading. The healthcare system has been slow to understand, exploit, and incorporate information technology for its practical and strategic functionalities [1].

The American College of Radiology (ACR) and the National Electrical Manufacturers Association developed the DICOM (Digital Imaging and Communications in Medicine) Protocol, a standard method

for transferring images and information between medical imaging devices and radiology information systems [2].

Most hospitals in Egypt use digital radiodiagnostic modalities that support the DICOM protocol. The implementation of the DICOM modality worklist system in the diagnostic radiology department of the Minia Oncology Center led to significant improvements in efficiency, accuracy, and satisfaction for both patients and staff. These results underscore the value of such systems in healthcare settings, providing clear evidence for enhanced operational performance, patient care quality, and better resource management [3].

This study aimed to prove the impact of integrating the DICOM modality worklist with the radiology information system on the patient registration process and workflow. This study assessed the following points:

- Patient registration times
- Data accuracy
- Patient and staff satisfaction
- Resource utilization: it includes the time needed for registration staff to manually register the patient and the number of technicians needed (per patient per imaging modality as well as time consumed on each imaging modality) to introduce patient data manually.

## Materials and Methods

The Minia Oncology Center faces challenges in managing patient registration efficiently. In the diagnostic radiology department, manual processes often lead to long waiting times, data entry errors, and overall inefficiency.

The study employs a mixed-methods approach that incorporates both quantitative and qualitative data by comparing pre-and post-implementation data.

The study included 500 patients, five registration staff, and 10 radiology technicians. The included radiological modalities in this survey are MRI, CT, and mammography. Data was collected through surveys, interviews, and direct observation. Pre-implementation data were gathered for two months, followed by a one-month implementation period, and post-implementation data were collected for another two months.

Metrics overview used in this study were as follows:

1. Registration time for the patient, minutes
2. Total number of errors in data entry (per 100 cases)
3. Resource utilization:
    - Time consumed on each imaging modality per patient, minutes
    - Registration staff time per patient, minutes
    - Number of technicians needed (per patient per imaging modality)
4. Number of non-satisfied patients per whole number of asked patients
5. Number of non-satisfied registration staff per whole number of asked staff
6. Number of errors in data entry per imaging modality type/study time.

## Results

The evaluated metrics showed a decrease in all evaluated metrics (Table 1) with a reduction in patient registration time, decreasing by approximately 66.7% from 15 minutes pre-implementation to less than 5 minutes post-implementation, a substantial reduction in data entry errors, decreasing by 87.5%, from 40 errors per 100 cases pre-implementation to 5 errors per 100 cases post-implementation, machine time decreased by 80%, registration staff time decreased by 60%, technicians needed (per patient per examined

modality) decreased by 50%. The number of satisfied patients increased by 180%, and the number of satisfied staff members increased by 80% (Table 1).

**Table 1**. Key Performance Metrics Before and After Implementation.

| Metric | Pre-Implementation | Implementation | Post-Implementation |
|---|---|---|---|
| 1. Registration time for the patient, minutes | 15 | 10 | <5 |
| 2. Total number of errors in data entry (per 100 cases) | 40 | 30 | 5 |
| 3. Resource utilization: | | | |
| - Time consumed on each imaging modality per patient, minutes | 15 | 9 | <3 |
| - Registration staff time per patient, minutes | 5 | 3 | 2 |
| - Number of technicians needed (per patient per imaging modality) | 6 | 4 | 3 |
| 4. Number of non-satisfied patients per whole number of asked patients | 350 | 200 | 80 |
| 5. Number of non-satisfied registration staff per whole number of asked staff | 5 | 3 | 1 |
| 6. Number of errors in data entry per imaging modality type/study time | | | |
| MRI | 10 | 5 | 1 |
| CT | 10 | 12 | 2 |
| Mammography | 20 | 13 | 2 |

## Discussion

The development and acceptance of the DICOM standard have become a basic requirement for implementing electronic imaging in radiology. DICOM now provides a standard for electronic communication between radiology and other parts of the hospital enterprise [4].

The Modality Worklist function allows an automated, reliable, error-free transfer of information stored in the HIS directly to the modality, supported by almost all manufacturers of digital DICOM modalities [5].

Unreliable data can directly impact patient care when images are labeled incorrectly and stored incorrectly on the PACS, rendering them incomplete, mismatched, unmatched, or simply missing [6].

At our center, we have been utilizing PACS for nearly three years. In a PACS environment, even minor errors in data entry can cause severe workflow disruption. For example, a space entered at the keyboard instead of a hyphen, or an extra space between the first and last names, might render an accession number useless. These errors usually require manual intervention, which is time-consuming and can disrupt workflow and compromise the accuracy of the electronic medical record [7].

The radiology process is initiated by a request for a radiology procedure for a specific patient, usually part of a radiology order that may request multiple procedures. Each requested procedure generates a different result instance, leading to a radiology report containing the interpretation and impressions of the radiologist [8].

DICOM provides a network transaction that enables users to query for reporting tasks. The DICOM worklist enables a system to query a reporting work list from a workflow manager using query keys, and the work list provider answers the query by sending a list of matching work items. The DICOM system performing the reporting task can send feedback about the actions taken, including the performer's identity and the action date and time [9].

## Conclusions

The implementation of the DICOM modality worklist system at the Minia Oncology Center has proven effective in enhancing patient registration efficiency, reducing errors, and improving both patient and staff satisfaction. The integration of HIS-RIS-PACS systems, facilitated by the DICOM protocol, is crucial for any hospital seeking to improve operational performance and patient care quality. The significant improvements observed in this study highlight the indispensable role of DICOM in modern medical imaging and patient management systems.

**List of Abbreviations:** MRI: Magnetic Resonance Imaging; CT: Computed Tomography; ACR: American College of Radiology; HIS: Hospital Information System; RIS: Radiology Information System; PACS: Picture Archiving and Communication System; DICOM: Digital Imaging and Communications in Medicine

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# Data Augmentation and Lightweight Convolutional Neural Networks in Classification of Thoracic Diseases

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## Abstract
The medical field has seen a tremendous transformation due to technological breakthroughs, with advanced medical imaging techniques becoming indispensable for diagnosis and treatment. Convolutional neural network (CNN) models have demonstrated remarkable accuracy in analyzing and classifying medical images, often surpassing human performance. In this study, we contrast two important methods for classifying medical images: lightweight CNN models (that are tailored for devices with limited resources) and data augmentation (to improve model generalization). Evaluating these models' effectiveness and performance in identifying thoracic illnesses, such as breast cancer, COVID-19 effects, and pneumonia, is the main goal. To enhance model performance, the study used preprocessed and augmented publicly available chest X-ray scans and computer tomography images. Specific CNN models used in the experiments are MobileNet, EfficientNet-B0, ResNet50, and DenseNet121. The state-of-the-art for these models show that despite lowering the danger of overfitting, data augmentation greatly increases model accuracy. Lightweight models provided the best possible compromise between accuracy and resource efficiency, performing on par with complicated models. The suitability of lightweight models for portable medical equipment was validated by testing on devices with limited resources, allowing for quick and precise pre-diagnosis. In addition to highlighting the potential of lightweight CNN to increase diagnostic accessibility, these findings emphasize the importance of striking balancing performance and efficiency in medical applications, particularly in resource-limited settings.

**Keywords:** Convolutional Neural Networks (CNN); Data Augmentation; Lightweight Models; Medical Images; Classifications.

# Dementia Classification Based on Magnetic Resonance Scans Comparing Traditional and Modern Machine Learning Models' Quintessence

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## Abstract
Dementia is a neurodegenerative condition that affects many people globally, and early diagnosis is essential to slow down its progression. This paper aimed to analyze and compare several machine learning models used for the classification of Magnetic Resonance Imaging (MRI) scans of patients with or without dementia. To achieve this, we utilized multiple open-source datasets, such as the Alzheimer MRI Disease Classification Dataset and the Augmented Alzheimer MRI Dataset. The tested models include a few-layers Convolutional Neural Network (CNN), a Residual Neural Network (ResNet), a Vision Transformer (ViT), an Autoencoder, and the Random Forest actions, and their training was conducted in Google Colab on an Intel Xeon CPU with 2 vCPUs and above 10 GB RAM. The performance evaluation of each model was based on metrics such as accuracy, sensitivity, specificity, and statistical errors (determination coefficient, mean squared error, root mean squared error). Preliminary results indicate that ResNet achieves the highest accuracy (98.98%), followed by few-layers CNN (94%) and Random Forest (91%). ViT showed variable performance depending on the dataset, ranging between 48.83% and 99.64%, while the Autoencoder had lower classification performance (71.64% - 89%), being more suitable for data preprocessing. Deep neural network-based models, ResNet and ViT, demonstrated the best classification capabilities for individual datasets. Parameter optimization and data adaptability to requirements could further improve the obtained performance.

**Keywords:** Dementia Classifications; Medical Imaging; Machine Learning Models; Statistical Indicators; Evaluation Metrics.

# Enhancing Risk Prioritization in Healthcare Informatics: A Combined Vulnerability Scoring and Operational Framework Approach

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## Abstract
Effective risk prioritization in healthcare informatics is critical for safeguarding operational continuity and patient safety. Traditional risk management frameworks in healthcare cannot often holistically address technical vulnerabilities and operational urgencies. To overcome this limitation, this study introduces a novel Risk Priority Number (RPN) calculator that integrates the Common Vulnerability Scoring System (CVSS) and the Information Technology Infrastructure Library (ITIL) into a single, unified risk assessment model. Developed using Python and PyQt5, the standalone application was validated using 20 synthesized hospital IT (Information Technology) issues at Peamount Healthcare, including examples such as system clock-in failures, annual leave miscalculations, and scheduling errors. The scoring algorithm employs weighted formulas: 60% weight is assigned to technical severity (CVSS), and 40% to operational urgency and impact (ITIL), providing a comprehensive view of each issue's priority level. The tool categorized 40% of the issues as high-priority and 20% as critical, demonstrating the calculator's ability to triage risks effectively. The scale of impact included payroll disruptions, workflow inefficiencies, and delays in patient service processing—issues that affect both compliance and staff productivity. The combined CVSS-ITIL approach significantly enhances the accuracy of healthcare risk prioritization, providing actionable, standards-aligned recommendations. Future development aims to incorporate artificial intelligence for automated risk detection and broader usability across healthcare settings. The application represents a scalable, research-driven innovation that supports operational resilience and decision-making in critical healthcare infrastructures.

**Keywords:** Risk Priority Number (RPN); Common Vulnerability Scoring System (CVSS); Information Technology Infrastructure Library (ITIL); Healthcare Informatics; Risk Assessment.

# TB-Monitor: Advancing Tuberculosis Management Through Innovative Technologies

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## Abstract
Tuberculosis (TB) remains a major global health challenge, requiring ongoing efforts in surveillance, treatment optimization, and adherence monitoring. Effective TB management relies on early detection, consistent treatment compliance, and the prevention of disease transmission. Current monitoring approaches, including microbiological diagnostics, imaging techniques, and adherence-tracking systems, are often hindered by issues such as delayed diagnosis, drug resistance, and patient non-compliance. While high-income countries have established national TB surveillance systems, low- and middle-income nations continue to face significant gaps in patient monitoring and personalized treatment adjustments. To address these challenges, a digital TB monitoring platform has been developed, integrating mobile technology and the potential application of artificial intelligence to enhance patient engagement and healthcare decision-making. This platform enables patients to track medication adherence, symptoms, and lifestyle factors, while providing healthcare professionals with real-time access to patient data, allowing for timely treatment modifications and personalized interventions. Insights from the initial implementation phase highlight variations in patient engagement and the need for further optimization of digital adherence tools. Nationwide adoption of this platform would require regulatory support and policy integration but holds great potential to improve TB management, enhance treatment outcomes, and contribute to global TB eradication efforts.

**Keywords:** Mobile Application; Tuberculosis; Adherence-tracking; Personalized Treatment.

# Enhancing Lung Cancer Detection through Dual Imaging Modality Integration

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## Abstract
Lung cancer remains the leading cause of cancer-related deaths worldwide, highlighting the urgent need for more effective diagnostic tools. Probe-based confocal laser endomicroscopy (pCLE) provides real-time, high-resolution imaging of lung tissue at a microscopic level, yet its diagnostic precision could be further enhanced. This study explores a dual transfer learning (TL) strategy that incorporates histological imaging data to refine the accuracy of pCLE-based lung cancer classification. The research involved patients undergoing lung cancer surgery, from whom both histological and pCLE images were obtained. These images were compiled into balanced datasets containing both benign and malignant samples. Three convolutional neural network (CNN) models—AlexNet, GoogLeNet, and ResNet—originally trained on ImageNet, were either fine-tuned using only pCLE images (confocal TL) or underwent a dual TL process, where they were first trained on histological images before adapting to pCLE data. Results demonstrated that the dual TL methodology consistently outperformed the confocal TL approach. Among the models, AlexNet achieved the highest accuracy at 94.97% with an AUC of 0.98, outperforming GoogLeNet and ResNet. All models exhibited statistically significant performance enhancements with dual TL (Student's t-test, $p < 0.001$). Additionally, models trained using dual TL showed reduced false positive and false negative rates, with class activation mapping confirming improved focus on diagnostically critical areas. By integrating histological and pCLE imaging, the dual TL framework significantly improves classification accuracy for lung cancer detection, making it a promising technique for further developments.

**Keywords:** Lung Cancer; Detection; Dual Imaging Modality; Deep Learning; Transfer Learning (TL).

# Real-Time Liver Lesion Segmentation in Ultrasound Imaging using Deep Learning

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## Abstract
Ultrasound (US) imaging is a widely used, non-invasive method for detecting liver tumors and assessing parenchymal changes. However, the inherent variability and noise in US images pose challenges for accurate lesion identification. This study aims to develop and evaluate a deep learning (DL) model capable of performing real-time segmentation of liver lesions in US scans. A dataset of 50 video examinations was used, from which frames were extracted and manually annotated by an experienced gastroenterologist. The segmentation process was conducted using a U-Net architecture with focal Tversky loss (FTL) to address class imbalance. Two versions of the model were trained with different FTL parameters: Model 1 ($\alpha = \beta = 0.5$, $\gamma = 1$) and Model 2 ($\alpha = 0.7$, $\beta = 0.3$, $\gamma = 0.75$). The models were assessed based on key performance metrics, including intersection over union (IoU), recall, and precision. Model 1 achieved a higher IoU score (0.84) than Model 2. Both models demonstrated inference times between 30 and 80 milliseconds, confirming their feasibility for real-time US applications. Visual analysis showed that Model 1 produced more precise and contiguous lesion segmentation, whereas Model 2 tended to separate lesions that were close together. These findings suggest that the proposed DL models are effective in real-time liver lesion segmentation in US imaging. Model 1, which utilized balanced FTL parameters, demonstrated superior segmentation accuracy.

**Keywords:** Ultrasound Imaging; Liver Tumor; Segmentation; U-Net; Focal Tversky Loss; Real-Time.

# Optimization of PLGA-Doxorubicin Hybrid Nanoparticles Using Design of Experiments: Synthesis, Characterization, and Applications

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## Abstract

*Background and Aim:* Poly (lactic-co-glycolic acid) (PLGA) exhibits a range of advantageous properties, including tunable particle sizes, stability, biodegradability, and the potential for surface functionalization. These characteristics have established PLGA as a widely utilized material in drug delivery systems. The aim of this study was to incorporate doxorubicin into PLGA nanoparticles using a Design of Experiments (DoE) approach, facilitated by MODDE13 software, to optimize formulation parameters and enhance drug delivery efficiency. *Materials and Methods:* To address design constraints and minimize the number of experimental runs, a full factorial design was employed, incorporating three factors—concentration of polyvinyl alcohol (PVA), stirring speed (Speed), and stirring time (Time)—and three responses—particle size (Size), zeta potential (ZP), and encapsulation efficiency (EE). The encapsulation efficiency of doxorubicin in PLGA nanoparticles was determined using spectrophotometric methods. For chromatographic analysis, an HPLC instrument (Vanquish Core LC system, Thermo Fisher Scientific, USA) equipped with a manual injector and a Diode Array Detector (DAD) was utilized. Chromatographic separation was performed using an Acclaim™ column with internal dimensions of 4.6 mm in diameter × 100 mm in length and a particle size of 5.0 µm. *Results*: Eleven experiments were conducted based on three levels of each independent variable. The experimental data were fitted to a polynomial model, enabling the prediction of the effects of formulation factors on PLGA-doxorubicin hybrid nanoparticles. The coefficients for the designed model were used to derive the following equations for each response: Size = 255.46 – 50*PVA – 92.5*Speed – 17.5*Time + 25*(PVASpeed) + 7.5*(SpeedTime); ZP = -2.11 – 0.01*PVA – 0.02*Speed + 0.01*Time; EE = 66.82 + 8.1PVA + 3.1Speed + 3.1Time + 3.1PVATime + 3.1Speed*Time. *Conclusions*: The results demonstrated that to maximize the size of PLGA-doxorubicin hybrid nanoparticles, optimal conditions included 1% PVA, a stirring speed of 10,000 rpm, and a stirring time of 2 hours. Furthermore, to simultaneously maximize both particle size and encapsulation efficiency, the optimal conditions were 1.2% PVA, a stirring speed of 10,000 rpm, and a stirring time of 2 hours. Under these conditions, a particle size of 440 nm and an encapsulation efficiency of 59.2% were achieved.

**Keywords:** Poly Lactic-co-Glycolic Acid (PLGA); Doxorubicin; Design of Experiments; Encapsulation Efficiency.

# Emerging Healthcare Technologies in Gastrointestinal Endoscopy: 75 Years of Evolution

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## Abstract

*Introduction*: Over the past 75 years, gastrointestinal endoscopy (GIE) has undergone remarkable transformative advancements that continue to shape its future. *Material and Methods*: A comprehensive literature search was conducted to gather relevant studies on emerging technologies in GIE. The databases search strategy employed a combination of keywords and Medical Subject Headings terms such as "endoscopy," "emerging technologies," "advanced imaging," "molecular imaging,". *Results*: The journey of GIE began in the 1950s with rigid endoscopes, followed by the introduction of fiber-optic technology and flexible scopes in the 1960s-1970s. The 1980s witnessed the emergence of digital imaging, whereas the 21st century has been marked by High-Definition and Narrow-Band Imaging, improving mucosal visualization and lesion detection. Microscopic imaging techniques, such as Confocal Laser Endomicroscopy, Volumetric Laser and Multiphoton Endomicroscopy, Optical Coherence Tomography provide histology-like images for real-time tissue assessment without biopsies. One of the most significant advancements is AI-driven endoscopy systems (EndoBrain, NvisionVLE, EndoAngel, GI Genius). Machine learning algorithms assist in real-time polyp detection, classification, and predictive analytics, enhancing diagnostic accuracy while reducing inter-observer variability and human error. Machine learning is advancing rapidly, but clinical implementation faces challenges, such as algorithm validation, interpretability, and regulatory concerns. Robotic-assisted endoscopy (EndoMaster, Magnetically Assisted Robotic Endoscopy) provides enhanced dexterity and stability, making complex procedures safer and more efficient. In therapeutic endoscopy, Endoscopic Submucosal Dissection and Endoscopic Mucosal Resection have expanded the therapeutic scope of GIE enabling minimally invasive removal of early-stage tumors, reducing the need for surgery. Endoscopic Ultrasound has advanced to include Fine-Needle Biopsy, improving tissue sampling accuracy. Single-use endoscopes are gaining popularity for reducing the risk of infection. Capsule endoscopy has revolutionized non-invasive small intestine evaluation, with advancements such as Magnetically Controlled Capsules and Chained Flexible Capsules enhancing maneuverability and precision in visualizing the digestive tract. Future capsules will feature AI-driven lesion detection and therapeutic functions, higher-resolution imaging, wider fields of view, controllable movement bringing the concept of "swallowing the gastroenterologist" closer to reality. *Conclusions*: The future of GIE is driven by AI integration, molecular imaging, and robotics ushering in a new era of precision medicine. With strategic partnerships and technological integration, endoscopy's future promises significant benefits for healthcare professionals and patients alike.

**Keywords:** Gastroenterology; Endoscopy; Endoscopy AI (Artificial Intelligence); Wireless Capsule Endoscopy; Diagnostic Imaging.

# An Exploration of Mathematical Models for Tumor Growth

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## Abstract
*Introduction*: Experimental research often involves measuring the effects of various interventions on tumor growth. Animal tumor models can be based on induced tumors or transplanted tumors. The growth patterns of such tumors are relevant in order to properly quantify the outcomes of various treatment interventions. *Aim*: The primary aim of this study was to explore systematically mathematical models for tumor growth and to characterize these models. *Methods*: Basic types included models based on empirical equations like the Michaelis-Menten equation, saturated exponentials, fractions of exponentials, as well as models based on differential equations, like logistic growth and polynomial fractions. Furthermore, various variations of the base models were compared to the base models. Linear combinations and non-linear combinations of the primary models were also included in the analyses. The asymptotic volume of the tumor was considered fixed. Analysis was performed using the R statistical framework. *Results*: All models converged to the final tumor volume. However, variation of the model equations enabled the generation of a great diversity of growth curves with varying rates of convergence compared to the base types. The base models included the maximal volume and one additional rate parameter, while the variants included up to three modifying parameters. These models can be further combined using linear or non-linear combinations to generate even greater diversity, with the drawback of doubling the number of parameters. A large log-likelihood can easily outgrow the increase in information criteria (like AIC or BIC) resulting from one or two more parameters in the simple variants. *Conclusions*: It was possible to construct many mathematical models for tumor growth starting from some basic types of non-linear or differential equations. Validation of these models should be performed on various sets of real data.

**Keywords:** Tumor Models; Logistic Growth; Saturating Exponential.

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# Predictive Analysis of Cardiovascular Disease Risk Factors in Romania using Machine Learning and Medical Statistics

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## Abstract
Cardiovascular disease (CVD) remains one of the leading causes of morbidity and mortality in Romania, being a severe public health problem. The aim of the present study was to identify and assess the significant risk factors of CVD and develop evidence-based prevention strategies. To do this, we used machine learning algorithms such as logistic regression, random forests, support vector machines (SVM), and artificial neural networks (ANNs) to forecast cardiovascular risk factors from past medical data and epidemiology trends. We also used inferential methods such as logistic regression, Cox proportional hazards models, and survival analysis for validation and interpretation of results. Our findings identify the most powerful determinants of cardiovascular disease in Romania, with an integrated risk model evaluation. Based on our findings, a series of preventive interventions and policy recommendations for cardiovascular risk reduction at the individual and population levels can be implemented. Our results are able to assist health authorities in planning more successful intervention programs and provide individuals with useful strategies with which to reduce their own risk of CVD.

**Keywords:** Cardiovascular Disease (CVD); Risk Factors; Machine Learning; Medical Statistics; Predictive Modeling.

# Generative Artificial Intelligence in Medicine: Has ChatGPT the Potential in Assisting Dermatologists?

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## Abstract
Although Generative Artificial Intelligence has been around for quite some time, the recent surge in interest in this subject was caused by the launch of OpenAI's chatbot. ChatGPT is an artificial intelligence model that processes natural language and outputs information according to the input provided by the user. The responses are contingent upon the model used for the inquiry and the user's desired output. The launch of the 4o model created a frenzy among technology enthusiasts, as it bridged some of the gaps documented in the research literature for the previous models (i.e. acceptance of image and audio input/output). Considering the improved capabilities of the 4o version, there was room to ask whether this tool could be reliable in dermoscopic image diagnosis and, also, how the variety in possible diagnoses of input data might affect the accuracy of its responses. To test the accuracy of the 4o model two datasets were used, both containing dermoscopic images randomly chosen from the ISIC archive gallery (https://gallery.isic-archive.com/), with diagnoses confirmed through histopathology. The first dataset consisted of 60 dermoscopic images of multiple skin diseases, whereas the other included 60 images of nevus, carcinoma, and melanoma images (20 images per label). Two chat sessions were initiated on 10th of February using a ChatGPT Plus subscription, each corresponding to one of the datasets. In the first session, each inquiry asked for the most likely diagnosis, whereas in the second one a list with possible diagnoses was first provided, and only afterwards were the images input. The results show improved accuracy in the second chat, where approximately 53% of the images were labeled correctly, as opposed to the first one, which had a success rate of only 20%. The preliminary findings indicate that the 4o model shows promise as an assisted tool in diagnosis of dermoscopic images. However, further research is necessary to establish its reliability as a standalone diagnostic instrument.

**Keywords:** ChatGPT; Medical Education; Artificial Intelligence (AI); Chatbot; Dermatology.

# Digital Assistant for Medical Management

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## Abstract
Currently, in Romania, several solutions exist regarding medical information management and communication between patients and healthcare professionals. However, these solutions have certain limitations in providing centralized access to medical records and ensuring the control over personal medical data. This study aimed to analyze existing digital healthcare applications and identify their strengths and weaknesses, to propose a more comprehensive approach. The analysis was conducted comparing a few of the major platforms available: Regina Maria, Sanador and MedLife, which are widely used in Romania. Each platform was evaluated based on its functionalities, accessibility, and ability to provide efficient medical management. The results show that Regina Maria's application focuses on appointment scheduling and access to medical information related to its clinics, also offering an educational section. Sanador provides features similar to Regina Maria, allowing online appointment booking and limited access to medical records, specifically laboratory test results. MedLife, on the other hand, covers a broader network of medical institutions and provides access to test results and consultation scheduling. Despite their benefits, all three platforms lack full integration of patient medical records, and a more direct communication between patients and doctors. To address these gaps, an improved digital healthcare solution should offer centralized medical record management, direct communication with doctors, and expanded functionalities such as automated appointment notifications, access to first aid instructions, e-prescription services, and medication reminders. Additionally, features like an interactive map for locating clinics and pharmacies, a personalized treatment calendar, and a dedicated medical education section would enhance usability. The inclusion of a review system for doctors and clinics would also contribute to better patient decision-making.

**Keywords:** Medical Records; Digital Healthcare; Patient-Clinic Communication; Patient Control.

# Operationalizing Human Health Indicators to Link with Ecosystem Changes of Water Streams: An OneAquaHealth Protocol

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## Abstract
*Background*: Stream buffer and riparian zones surrounding urban water bodies have profound impacts on the health and well-being of human communities who live near streams. Among the aims of the OneAquaHealth project is to set up a framework to detect and monitor human health outcomes linked to ecosystem changes in urban streams in five European cities (Coimbra, Benevento, Toulouse, Ghent, Oslo, Heraklio). The objective of this particular protocol is to examine how human health indicators can be identified, measured and sampled to explore the relationship between human health and urban freshwater ecosystems. *Methods*: Activities in OneAquaHealth are implemented under the OneDigitalHealth (ODH) framework. Operationalizing health indicators for well-being, mental and physical health, physical activity, restorative experience, annual mortality within this framework involves a comprehensive process of integrating diverse health and ecosystem data to create actionable tools for improving public health and environmental sustainability. This includes quantifying the interconnections between urban aquatic ecosystems and human health using citizen science approaches, classic domain-expert, statistical and AI-driven approaches (e.g. large language models) and designing an alignment model that account for disparities regarding health-related data availability and quality. Mechanisms will be established for collecting and integrating data, considering the heterogeneous data sources; e.g. literature reviews, health registries, community surveys, citizen science and large language models for screening literature and extracting indicators. Health indicators will be identified based on relevance and feasibility, considering that their availability and quality can change over time and between sites. Indicator selection will be relevant to levels of granularity, meaning the degree of details or specificity, the degree of precision depending on how the values were collected, the time distance between the data collection and the effective use and the correlation (known or expected) with aquatic ecosystem health indicators (e.g biodiversity, pollutant levels, water pH). A foundation for standardizing and operationalizing the indicators will be created, including controlled vocabularies and ontologies (e.g. the Medical Informatics Digital Health Multilingual Ontologies), a framework alignment for categorizing human health and ecosystem health indicators into the ODH dimensions, an indicator scoring system to evaluate integration withing the ODH, fitting and enhancing via operationalization a specific list of Digital Determinants of Health using the digital clusters suggested by WHO Data and Digital Health, data quality assurance under the FAIR principles, performance reviews by evaluating the reliability and impact of metrics and data collection methods, stakeholder feedback and iterative improvements to update models, indicators, and

analytics based on emerging data and technologies. Leveraging advanced computational methods will be performed to integrate the collected data and analyze data related to indicators. Predictive modelling, geospatial and trends analyses, and causal relationships between ecosystem changes and health outcomes to inform evidence-based decision-making will be developed. This will support (near) real-time monitoring of indicators, enabling dynamic updates and allowing decision-making in due time. *Conclusion/Anticipated Impact*: The operationalization of the health indicators from the various sources and applied strategies will lead to transforming insights (indicators and their related analysis) into practical interventions, such as policy recommendations (advice on urban planning, water management, public health initiatives), health interventions (targeted campaigns to address health risks, e.g. water safety education, disease prevention measures), preparedness planning (strategies for managing natural disasters, e.g. floods, droughts), multidisciplinary collaboration (with public health experts, environmental scientists, and policymakers for comprehensive solutions) and community participation (empowerment through education and involvement in data collection and interpretation).

**Keywords:** Human Health; Ecosystems; Urban Freshwater Streams; Geographic Information Systems (GIS); One Digital Health.

**Acknowledgments:** This work is supported in part by EU H2020 Project OneAquaHealth GA101086521.

# Human Health Outcomes Linked to Ecosystem Changes of Urban Streams: An OneAquaHealth Protocol

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## Abstract

*Background*: Stream buffer and riparian zones are critical areas surrounding water bodies with profound impacts on the health and well-being of human communities who live near streams. Among the aims of the OneAquaHealth project is to set up a framework to detect and monitor human health outcomes linked to ecosystem changes in urban streams in five European cities (Coimbra, Benevento, Toulouse, Ghent, Oslo). The objective of this particular protocol is to establish a data collection structure to identify environmental pressure, human exposure, and feedback mechanisms between ecosystem and the health of people living near the urban streams. *Methods*: Geospatial health mapping, particularly remote sensing and Geographic Information Systems (GIS) will be used to correlate health indicators (well being, mental and physical health, physical activity, restorative experience, annual mortality) with environmental changes through the years. Ecosystem health and services assessment will be further implemented to assess water quality (contaminants, waterborne diseases), species biodiversity (diatoms, vegetation) both inside the water and in the riparian zone around the stream and soil health (contamination, erosion, and agricultural activity). This will be performed using public databases to collect information for the selected stream, remote sensing (aerial photos, satellite imagery) and field surveys (for example geophysical mapping at selected sites). The research will be conducted for a certain period so that data can be collected at various spatial and temporal scales to detect patterns over time and provide reliable predictions using machine learning models. *Conclusion/Anticipated Impact*: The protocol is flexible for monitoring human health in relation to ecosystem degradation. The integration of health and environmental data and the employment of modern tools like GIS enables this system to detect health risks timely. The emphasis on real-time monitoring and community engagement provides a capable framework to manage the growing health challenges posed by environmental degradation and climate change.

**Keywords:** Human Health; Ecosystems; Urban Freshwater Streams; Geographic Information Systems (GIS); One Digital Health.

**Acknowledgments:** This work is supported in part by EU H2020 Project OneAquaHealth GA101086521.

# The Impact of Clinical Audits on Improving the Healthcare System in Romania

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## Abstract

*Background and Aim:* Clinical audits are essential when it comes to improving healthcare quality by ensuring compliance with established standards. However, in Romania, clinical audits remain underdeveloped compared to other European healthcare systems despite their inclusion in the National Health Strategy 2023–2030. While audits are crucial in identifying inefficiencies and enhancing patient safety, their implementation faces limited resources, inconsistent application, and insufficient training. Our study aimed to evaluate the effectiveness of clinical audits in Romania and propose solutions for optimizing their implementation within the healthcare system in Romania. *Materials and Methods:* The study was conducted between April 23, 2024, and June 11, 2024, in several public hospitals in Romania. A mixed methods approach used quantitative data from structured surveys and qualitative data from interviews. Surveys were distributed by e-mail to health professionals registered on the National Authority for Quality Management (ANMCS) database. Participation was voluntary, and the sample consisted of professionals who responded to the invitation sent to official hospital contacts available on the ANMCS website. To increase the response rate, a follow-up reminder was sent by e-mail on June 6. Respondents had the option to continue with follow-up interviews to provide more detailed information regarding the importance of the audit. Data analysis involved statistical interpretation of survey responses and thematic coding for the qualitative data. *Results:* A total of 200 respondents participated in the study, including 73 heads of quality management (36.5%), 71 physicians (35.5%), and 56 nurses (28%). The majority of respondents were women (160, 80%). Regarding geographical distribution, 87% of the respondents were from urban areas, while 13% were from rural areas. Respondents from different rural areas participated, with the highest representation from urban medical centers. Most health professionals recognize the importance of audits in improving patient care. However, barriers such as inadequate education on audit processes, inconsistent implementation, and limited institutional support hampered their effectiveness. Hospitals with structured audit procedures demonstrated better patient outcomes and compliance with healthcare standards. *Conclusion:* Clinical audits are positively perceived by most participants. The findings highlight the need for regular audit activities in Romanian hospitals and their stronger integration into the healthcare system.

**Keywords:** Clinical Audit; Healthcare Quality; Patient Safety; Healthcare Standards.

# Patients' Internet Use for Health-Related Purposes: A Cross-Sectional Study

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## Abstract

*Background and Aim*: Many people seek health information online, but misinformation can lead to incorrect medical decisions. The aim of the study was to assess patients' medical internet use and their intention to discuss online findings with doctors. *Materials and Methods*: The observational and cross-sectional study included a sample of patients with chronic non-communicable diseases who voluntarily participated in a health education and screening campaign, conducted in four cities in Romania during March-November 2024. Socio-demographic data and answers to seven specific questions were collected using a face-to-face questionnaire developed by the authors. The study was conducted with the approval of the ethics committee of George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Targu Mures. *Results*: The study sample included 495 respondents. The mean age of respondents was 48.7 years; 72.9% were females, and 73.4% resided in urban areas. Approximately half of the respondents (51.2%) had a high school education or less, while 48.7% had post-secondary or university education. Over 65% of respondents searched for health information online frequently or sometimes, while 34.4% did so rarely or never. Most respondents (90.9%) searched for medical information using a mobile device, while fewer used laptops (19.9%), tablets (11.3%), or desktops (10.8%). The vast majority (94.1%) used Google to find medical information, while fewer relied on websites (21.2%), social media (15.0%), forums (9.6%), or artificial intelligence chatbots (3.9%). The vast majority (81.6%) believed that it would be useful to discuss online health information with doctors. More than half (57.4%) had asked a doctor to explain medical information found online, while 35.2% had not. Most respondents (84.8%) received a response from their doctor: 50.8% obtained a detailed answer, while 34.0% received a brief one. However, 10.9% felt that their questions were avoided or unwelcome. *Conclusions*: Most respondents frequently search for health information online, mainly using mobile devices and Google. Many patients appreciate discussing the health information they find online with doctors, highlighting the need for professional guidance. While most doctors provided answers, some patients perceived reluctance or avoidance, suggesting room for better communication.

**Keywords:** Health Information Seeking; Online Medical Searches; Doctor-Patient Communication; Mobile Health Technology; Artificial Intelligence Chatbots.

# Data Confidentiality in Artificial Intelligence-Assisted Medicine: The Main Ethical Issue

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## Abstract

*Background and Aim*: The use of Artificial Intelligence (AI) in healthcare presents previously unheard-of chances for efficiency and innovation as these technologies develop quickly. However, these developments have also led to serious ethical problems, especially regarding patient privacy, data confidentiality, and informed permission. Our study aimed to investigate the primary ethical concerns surrounding data confidentiality in AI-assisted medicine, highlighting the significance of upholding integrity and trust in the rapidly changing healthcare industry. Concerns regarding data confidentiality are the main ethical issues raised by the use of AI in medicine. Processing enormous volumes of private patient data is part of the use of AI in healthcare, which raises questions about data breaches, misuse, and illegal access. To build public trust and protect personal health information, it is essential to ensure patient confidentiality and implement robust information security safeguards. *Materials and Methods*: The study entails gathering patient data from electronic health records (EHRs), anonymizing it, creating AI algorithms for recommending treatments and diagnosing diseases, putting strong security measures in place, abiding by ethical standards, identifying and reducing biases in AI algorithms, and making sure that laws like GDPR and HIPAA are followed. Additionally, it highlights data privacy and ethical issues. *Results*: The investigation shows that privacy-preserving methods for AI-based healthcare applications have advanced significantly. Combining several privacy-preserving techniques, known as *hybrid* techniques, has also showed promise in improving data security and reducing risks. Although improvements have been made, there remain issues with possible privacy threats. *Conclusion*: Maintaining data privacy in AI-assisted medicine is a complex issue that demands for an all-encompassing and moral strategy. Although there are many potential advantages of using AI to enhance medical care, they must be weighed against potential risks to patient privacy and data security. Securing informed consent, overcoming algorithmic biases, upholding stringent regulatory requirements, and preserving strong data protection procedures are all important ethical issues. The healthcare sector can use AI to its full potential while maintaining the highest standards of medical ethics and protecting patient confidence by prioritizing these ethical concerns.

**Keywords:** Artificial Intelligence (AI); Assisted Medicine; Confidentiality; Data; Ethics; Electronic Health Records (EHRs).

# Neural Networks vs. Regression: A Comparative Analysis in Medical Data Processing

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## Abstract
*Background and Aim:* The increasing adoption of artificial intelligence (AI) in medical research offered alternative methods for medical data processing. This study evaluated comparatively the predictive performance of feedforward neural networks (FFNN) regression versus classical statistical regression analysis in estimating the risk of post-COVID-19 type 2 diabetes based on metabolic factors. The primary objective was to assess the applicability, advantages, and limitations of these approaches when applied to relatively small medical datasets. *Materials and Methods:* We started with the analysis of a small dataset - 130 patient records with metabolic parameters [1]. The risk of post-COVID-19 type 2 diabetes (glycaemia at 4 and at 12 months post-COVID as function of metabolic parameters) was predicted using both linear regression and FFNN. The regression model followed standard statistical guidelines, while the FFNN required optimization of hyperparameters, including the number of layers, activation functions, learning rate, and optimization algorithms. We extended the study using simulated data to further compare logistic regression (a data set of 300 patients) with neural networks. *Results:* The classical regression models demonstrated stable performance with clear interpretability, offering well-defined coefficients and statistical significance measures. However, FFNN did not yield superior predictive accuracy, and its performance varied significantly depending on the choice of hyperparameters. The optimization process for NN required extensive trial and error, as no universal guidelines for parameter selection were applicable in this context. *Discussion.* Our findings highlight a real challenge in medical AI applications for data processing: when dealing with small datasets, neural networks do not necessarily outperform classical methods. Regression provided robust results with minimal computational effort, while FFNN required complex tuning without a clear performance advantage. The use of simulated data revealed that NN might be more effective in larger datasets with potential non-linear patterns, but limited interpretability. *Conclusion:* AI-based models are, indeed, recommended for data processing of large and/or unstructured complex medical data sets. However, as a conclusion of this study, regression models proved to be a more practical and reliable choice for small-scale medical predictions. Future work should explore hybrid models that combine interpretability with non-linear modeling capacity to optimize predictive accuracy in clinical settings.

**Keywords:** Neural Networks; Regression Analysis; Medical Data Processing; Predictive Modeling.

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# C-Reactive Protein-to-Albumin Ratio and First-Year Mortality in Incident Hemodialysis End-Stage Kidney Disease Patients

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## Abstract

*Background:* The association between low serum albumin and mortality in end-stage kidney disease (ESKD) is partly linked to systemic inflammation. C-Reactive Protein-to-Albumin Ratio is being analysed as a part of a multifactorial risk model. However, the extent to which albumin's association with mortality depends on systemic inflammation remains unclear. First-year mortality in incident hemodialysis (HD) patients is notably high, approximately 19.33%. This study aimed to assess the predictive value of the C-Reactive Protein to Albumin Ratio (CAR) for first-year mortality in incident HD patients.Previous studies have explored its role in HD mortality prediction. *Materials and Methods:* We analyzed mortality rates and risk factors for mortality during the first year of HD therapy in a large group of incident HD patients with ESKD. The study involved patients starting their first HD session from January 1, 2010, to December 31, 2024, at County Hospital Timişoara, excluding those on peritoneal dialysis. Data on death events, comorbidities at dialysis initiation, and pre-HD laboratory results were collected, with follow-up for one year or until transplantation. *Results:* In this retrospective observational study, we included a cohort of 332 incident HD patients (198 men and 134 women) with a mean age of 61.86 years. The overall mortality in the first year after HD initiation was 15.96% (53 individuals). Factors associated with death were high age, elevated Charlson comorbidity index, low estimated glomerular filtration rate, low high C-reactive protein (CRP) to albumin ratio, high serum uric acid, high ferritin level, low serum calcium, low 25-OH vitamin D level, signs of overhydration and hyperkalemia. Multivariable regression analysis revealed that CAR remained one of the independent predictors of death, with a HR (hazard ratio) =1.347, 95%CI(confidence interval): 1.209 to 1.501, P<0.001. *Conclusions:* We showed that CAR was significantly associated with a higher mortality risk in the first year of HD, underlining the prognostic significance of malnutrition and inflammation in patients starting HD therapy. For ESKD patients undergoing HD, combining serum albumin and CRP measurements, could improve the mortality risk prediction accuracy, and also it can be applied in clinical practice to improve the risk stratification.

**Keywords:** Albumin; Mortality; Inflammation; Kidney.

# The Use of Artificial Intelligence in Improving the Cost - Effectiveness of Cervical Cancer Treatment in the Western Region of Romania

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## Abstract:

*Background and Aim:* Romania has the most significant cervical cancer incidence and mortality rates in Europe, and there is an acute need for improvement. According to the guidelines set by the International Federation of Gynaecology and Obstetrics, different treatments can lead to similar rates of progression-free survival and overall survival in different stages of cervical cancer. The aim was to compare the main treatment plans' cost-effectiveness (CE) regarding survival rate and CE using artificial intelligence (AI) in the western region of Romania and to offer insight re-garding how to improve the statistics. *Materials and Methods*: Descriptive statistics and a correlation model have been used to investigate costs. Artificial intelligence (AI) models were elaborated to predict CE of different types of treatment using the published studies regarding overall survival rates and treatment-related toxicity rates for five years. The costs involving cervical cancer treatment were obtained from the public health department, the oncological clinic in the West Region of Romania, and the County Hospital, specifically for each stage. *Results*: The mean cost was €8,349.60 for stages IIA (surgery, chemotherapy, radiotherapy), IIIA, IIIB, and IIIC (surgery, chemotherapy, radiotherapy, brachy- therapy), followed by €3,705.20 for IIB (surgery, chemotherapy, brachytherapy), and IVA (chemo-therapy, radiotherapy). *Conclusions*: The costs that would increase as a result of cervical cancer if further steps are not taken to stop the disease's aggressive and quick spread among women of all ages. It has been noted that these costs are growing linearly, resulting in patients' quality of life being negatively impacted.

**Keywords**: Cost-effectiveness; Cervical Cancer; Treatment; Artificial Intelligence (AI); Surgery.

# Custom WordPress Plugin for Native-Like Digital Health Literacy Questionnaires: Supporting the ALSATION Study

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## Abstract
Health Literacy (HL) is a significant part of how people find and utilize health-related information. It refers to how people understand and make use of medical information in their lives. Moving into the digital era, health literacy has developed another crucial aspect: understanding, finding, and making informed decisions based on medical data and information found online. With this in mind, the World Health Organization designed four questionnaires for measuring digital health literacy in Europe. The ALSATION research team aimed to translate and culturally adapt the questionnaires into Romanian in seven steps [1]. The last three steps required a way to disseminate the translated versions to users in a non-biased and accessible manner. This study described how a custom plugin was employed to preserve the tabular structure and overall form's look and feel, ensuring an authentic questionnaire experience. This allowed users (step seven and six) and experts (step five) to evaluate the clarity and necessity of each form item and provide further recommendations. To the best of the author's knowledge, no existing plugins or third-party solutions allow for such a customized form. As a result, users can evaluate the translated questionnaires at any time in a clear and almost native-like questionnaire experience through the official webpage of the study [2].

**Keywords:** Web Development; Custom WordPress Plugin; Digital Health Literacy; Structured Data Collection.

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# Blockchain Technology for Secure Patient Data Sharing

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## Abstract
This paper presents a decentralized healthcare data management system that utilizes blockchain technology to address critical challenges in data security, patient privacy, and interoperability of electronic medical records (EMR). Traditional healthcare systems rely on centralized databases that are vulnerable to breaches, unauthorized access, and inefficient data sharing. By integrating blockchain's decentralized architecture, cryptographic security, and smart contracts, our system establishes a tamper-proof, patient-centric framework for EMR management. The proposed solution builds on foundational models such as MedBlock and MedRec, introducing novel enhancements like dynamic consent mechanisms, InterPlanetary File System (IPFS) for decentralized storage, and containerized deployment via Docker. Key innovations include storing medical records, including imaging files and diagnostic reports, on the IPFS, with cryptographic hashes anchored to the blockchain to ensure immutability and auditability. The frontend, developed using React for web interfaces and later ported to CustomTkinter for desktop applications, provides intuitive tools for patients and healthcare providers to interact with the blockchain. A containerized backend, orchestrated via Docker, integrates Node.js and Python microservices to handle IPFS uploads and real-time anomaly detection. The system's modular design supports deployment across diverse environments, from cloud servers to edge devices, ensuring scalability and resilience. By combining blockchain's decentralized trust model with modern cryptographic techniques and containerization, this work advances the state of secure, patient-empowered healthcare data management. A third iteration of the project is ongoing, integrating a Large Language Model (LLM) insides the application for assisting in treatment prediction and post-treatment risk prediction, as well as in scanning imaging results and providing a preliminary interpretation of them. Since the aim of our project is to develop a complex application for secure data patient sharing, there were no qualitative results measured yet, but will be presented once all proposed features will be implemented.

**Keywords:** Blockchain; Healthcare Data Management; Smart Contracts; Decentralized Systems; Patient-Centric Data Sharing.

# Efficient Storage Management of Optical Coherence Tomography Images using Zero-Shot Noise2Noise and a Custom Convolutional Neural Network

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## Abstract
Optical Coherence Tomography (OCT) produces high-resolution images that are critical for the diagnosis of ocular conditions. However, their large file sizes and high-resolution pose challenges for training convolutional neural networks (CNNs) to detect various diseases. To address this, we propose compressing OCT images using a denoising technique while preserving their diagnostic value. Our goal was to optimize storage usage and improve the efficiency of the CNN model in disease detection using compressed images. We employed the Zero-Shot Noise2Noise (ZS-N2N) denoising technique for image processing and a CNN for image classification. ZS-N2N is a denoising approach that can learn from OCT images without requiring clean reference images, effectively reducing noise and smoothing the images. The processed images were reduced to approximately one-third of their original file size (from ~100 KB to ~36 KB) while maintaining high structural similarity and visual clarity. Our experiment compared the performance of a binary classification model using both processed and unprocessed images from the Optical Coherence Tomography Dataset for Image-Based Deep Learning (OCTDL) dataset. When trained on unprocessed images, the model achieved 96% accuracy and took about 51 seconds to process and evaluate the test images. In comparison, the model trained on processed images achieved 91% accuracy and took about 42 seconds, demonstrating improved processing efficiency. Our results encourage further development of a classification model that leverages denoised and smoothed images with reduced storage size, balancing both accuracy and computational efficiency.

**Keywords:** Optical Coherence Tomography (OCT); Zero-Shot Noise2Noise; Convolutional Neural Network; Image Processing.

# Deep Learning-Based Denoising for Optical Coherence Tomography: Evaluating Self-Supervised and Generative Models Across Retinal Datasets

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## Abstract
Denoising medical imaging is crucial for enhancing diagnostic accuracy, particularly for Optical Coherence Tomography (OCT) scans used to detect retinal diseases. We aimed to evaluate the performance of five deep learning-based denoising models, namely Zero Shot Noise2Noise (ZS-N2N), DnCNN (for Gaussian denoising), U-Net Autoencoder, SwinIR Transformer, and CycleGAN. We used OCT scans with different retinal diseases datasets, such as diabetic retinopathy, age-related macular degeneration, macular hole, central serous retinopathy, and normal retinas. The models were trained using diverse OCT images and tested across these datasets to assess their generalization capability. Preliminary results indicated that ZS-N2N and CycleGAN consistently achieve the lowest loss and highest accuracy, making them the most effective for denoising across different pathologies. The DnCNN and U-Net Autoencoder exhibited moderate performance, with slightly higher loss values, likely due to their sensitivity to fine structural variations. SwinIR Transformer performs comparably to convolutional-based models but slightly underperforms on structurally complex conditions such as macular holes and central serous retinopathy. The accuracy values suggest that normal retina images achieve the highest denoising performance (approximatively 96% for ZS-N2N and CycleGAN). Overall, the results of our study highlights the effectiveness of self-supervised and generative adversarial approaches in preserving essential medical details while removing noise. Future work will involve refining these models with domain-specific augmentations and validating results on larger datasets.

**Keywords:** Optical Coherence Tomography (OCT) Denoising; Deep Learning (DL) in Medical Imaging; Retinal Disease Detection; Self-Supervised Learning; Generative Adversarial Network.

# The Usage of Robotic Process Automation and Artificial Intelligence for Handwritten Medical Document Digitalization

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## Abstract
This study presents two automatic approaches that can be applied to digitize medical handwritten forms. Both approaches utilize an RPA (Robotic Process Automation)-based software robot that converts the handwritten form into a digital entry. The RPA robot uses a taxonomy specific to medical form and associates the extracted data with the taxonomy. The first approach uses an OCR (optical character recognition provided by Google Cloud Vision/Azure Vision to create a DOM (Document Object Model) model. The second approach integrates the OpenAI ChatGPT4o model to extract handwritten medical data and transform them into typed data. In both approaches, the digitalized form is sent to a data extraction activity that uses UiPath's machine learning API to extract the data from the form. Because the medical form can not be found in the UiPaths standard templates, a data extraction template must be applied. After the data extraction process the saved data can be sent to a database, spreadsheet. The aim of the study was to determine which data extraction methods offer a better result. Access to this medical data is restricted to physicians and nurses employed at the specific medical facility. By creating new non-standard form templates and associated taxonomies, the system can be scaled as desired. It must be noted that the quality and readability of handwriting has a massive impact on the digitalization outcome. Using messy handwriting with Google Vision, the results were approximatively 65% of correct recognition after five runs on the same document, and using capitalized print letters, the result was approximatively 99%. Using the ChatGPT4o model the transcription had to be run at least three times to achieve 99% transcription on messy handwriting. The version with the capitalized print letter offered the best results using ChatGPT4o model.

**Keywords:** Robotic Process Automation (RPA); Artificial Intelligence (AI); Handwriting; Data Extraction.

# Using Crawlers for Targeted Data Extraction from a Local Multi-File Database

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## Abstract
*Background*: A crawler is a software program used to extract data in an automated manner. This study aimed to demonstrate how a crawler can extract specific data from multiple diverse .pdf files. *Methods and Materials*: To achieve this objective, a C# .NET9 application was developed, capable of processing a folder (local database) containing specific .pdf files. The application sequentially read each file and extracted relevant information. The ability of the crawler to extract the e-mail addresses of corresponding authors from academic papers was evaluated as a .pdf file may have contained multiple articles. In addition to email addresses, names of corresponding authors were extracted where possible. The PdfPig library was used to access the data since the input data were .pdf files. The output consisted of a CSV file containing all extracted email addresses. The input dataset included 19 books of abstracts and 180 articles. *Results*: During testing, the application managed to extract 929 email addresses and 77 names. However, due to pattern inconsistencies, name extraction was possible only for articles, not for books of abstracts. Further, evaluation on precision and accuracy was performed. While there was only 1 line extracted that did not contain emails out of the 880 lines, 34.55% of them needed corrective actions. In 213 instances text was attached to the e-mails (e.g. country names: Spain, Israel etc. or other words like keyword or abstract), country prefixes were attached in 156 cases and in 2 lines there additional full stops at the beginning or end of the e-mail. *Discussion*: Crawlers can be effective in extracting specific data from big databases of files simultaneously. In medical research, this ability can have an impact on productivity when dealing with data collection for research purposes. On the other hand, it poses a risk when personal information, e-mails in this case, become accessible for malicious purposes. Future work should explore compliance with data protection regulations, such as GDPR, and methods to ensure responsible data use. *Conclusion*: Besides the usefulness of crawlers in extracting email addresses, they prove their efficiency while dealing with the data gathering part of the research. By using a crawler, the researcher may be able to save some time, just by not dealing with the data extraction part of the study, while dealing with a large database of studies to cite.

**Keywords:** Crawler; C#; Automated Data Extraction; Email; Data.

# Decoding the Microbial Spectrum: Bioinformatic Approaches for Viruses, Bacteria and Fungi

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## Abstract
Next-generation sequencing is one of the most used techniques for pathogen research such as that on viruses, bacteria and fungi. Bioinformatics plays a very important role for processing, analyzing and interpreting huge datasets, therefore providing complete insights into pathogen evolution, antimicrobial resistance, mobile genetic elements (MGE) composition, etc. These are key features that could contribute to disease control and surveillance or even understanding underlying mechanisms for transmission. For viral sequencing bioinformatics we use genome assembly, variant calling and phylogenetic analyses, among other approaches, for tracking outbreaks or for identifying various strains and understanding the role of some particular viral mutations. For bacterial sequencing bioinformatics, we use whole-genome, 16S- and shotgun-metagenomics sequencing approaches for subtyping, resistance genes and MGE identification, among other approaches. Comparative genomics as well as pan-genome analyses help us explain bacterial adaptations and other mechanisms that could contribute to pathogenicity. For fungal bioinformatics we face unique challenges due to larger and more complex genomes (e.g. multiple chromosomes), the novelty of the pathogen (e.g. *C. auris*) and other particularities such as carrying specific traits (e.g. copy number variations) with yet unknown roles due to scarce annotation data. Some of the methods used involve quality control filtering and trimming performed with *HTStream* and *Trimmomatic*, *de novo* assembly and reference mapping with tools like *shovill* or *Snippy*, antibiotic resistance predicted with *ResFinder* or *CARD*, pangenome analysis with *Roary*, taxonomy profiling with Metaxa2 or huge phylogenetic analyses on fungi performed with *Pathogenwatch*.

**Keywords:** Bioinformatics; Sequencing; Viruses; Bacteria; Fungi.

# Transcriptomic Analysis of Peripheral Blood Mononuclear Cells in Hyperuricemia and Gout

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## Abstract

*Background and Aim:* Gout is one of the most common forms inflammatory arthritis characterized by deposits of monosodium urate crystals in joints, with an infiltration of neutrophils and macrophages. It is preceded by hyperuricemia, which despite being an asymptomatic condition is associated with multiple comorbidities. We performed a bulk Ribonucleic Acid (RNA) sequencing analysis of circulating blood mononuclear cells in volunteers with various level of serum urate and gout patients to identify the signature associated with the two conditions. *Materials and Methods:* Bulk RNA-sequencing from freshly isolated Peripheral Blood Mononuclear Cells was performed in 105 normouricemic controls, 21 hyperuricemic subjects and 71 gout patients, recruited at the Department of Rheumatology in Cluj-Napoca as part of the HINT study. The gout status was diagnosed based on the ACR/EULAR criteria and the threshold for hyperuricemia was set at 7 mg/dl serum urate. The Differential Expression analysis and quality control were performed with DESeq2(R). Sex and age were added as covariates in all comparisons. *Results:* The transcriptomic signature observed in hyperuricemia is similar to the one in gout with over 60% identical DEGs in both comparisons, which could be clustered into 2 main groups represented by the neutrophil activity and hemoglobin metabolism pathways. Further investigation identifies a positive correlation between Cluster 1 gene expression levels with neutrophil count and an inverse correlation between Cluster 2 genes with hemoglobin levels. A follow-up analysis that added these 2 variables as covariates shows close to no changes in Hyperuricemia and important inflammation pathways specific to Gout such as JAK/STAT signaling, Circadian Rhythm and NR4A receptors upregulation. *Conclusions:* This study identifies that granulopoiesis is the key factor that drives the inflammatory response observed in Hyperuricemia. Additional important pathways and genes were discovered in gout. We identified multiple similarities between this signature and those observed in other inflammatory and non-inflammatory diseases, suggesting a common response characteristic for chronic inflammation.

**Keywords:** Transcriptomics; Gout; Hyperuricemia; Inflammation.

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# Deep Learning Model for Automated Cutaneous Squamous Cell Carcinoma Grading

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## Abstract
Accurate and efficient grading of cutaneous squamous cell carcinoma (cSCC) is critical for effective treatment and prognosis, but traditional manual grading methods are subjective and time-consuming. This study aimed to develop and validate a deep learning (DL) model for automated cSCC grading, potentially improving diagnostic accuracy and efficiency. Three different deep neural network (DNN) architectures (AlexNet, GoogLeNet, and ResNet-18) were trained using transfer learning on a dataset of 300 histopathological images of cSCC. The performance of the models was evaluated based on accuracy, sensitivity, specificity, and area under the curve (AUC). A clinical validation was conducted on 60 images, comparing the DNNs' predictions with those made by a panel of pathologists. The DL models achieved high performance metrics (accuracy >85%, sensitivity >85%, specificity >92%, AUC >97%), demonstrating their potential for objective and efficient cSCC grading. The strong agreement observed between the DNNs and the panel of pathologists, as well as the consistency across different network architectures, further supports the reliability and accuracy of the DL models. The top-performing models have been made publicly available to facilitate further research and potential clinical implementation. This study highlights the promising role of DL in enhancing cSCC diagnosis and, ultimately, improving patient care.

**Keywords:** Cutaneous Squamous Cell Carcinoma; Deep Learning; Histological Grading; Transfer Learning; Artificial Intelligence.

# Spatial Distribution of Immune and Vascular Markers in Cutaneous Squamous Cell Carcinoma: A Fractal Dimension Approach

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## Abstract
Cutaneous squamous cell carcinoma (cSCC) is a prevalent and aggressive skin cancer with increasing global incidence, representing a significant public health challenge. Understanding the tumor microenvironment (TME) is crucial for improving treatment strategies. This study investigated the TME of cSCC by analyzing the spatial distribution of immune and vascular markers, addressing the need for quantitative methods to characterize tumor progression. We hypothesized that fractal dimension (FD) analysis could reveal differences in the spatial organization of these markers between pre-invasive and invasive cSCC lesions. The study included 141 cSCC cases (100 invasive, 41 pre-invasive, and a subset of peripheral pre-invasive lesions from the invasive group) collected between 2018 and 2022 at the Emergency Clinical County Hospital, Cluj-Napoca, Romania. Formalin-fixed paraffin-embedded tissue samples were immunohistochemically stained for CD31 (vascular marker), CD20 (B cell marker), CD4 (T helper cell marker), and CD8 (cytotoxic T cell marker). Fractal dimension analysis was performed to quantify the spatial distribution patterns of these markers. Fractal dimension values for each marker were compared between pre-invasive and invasive lesion groups using appropriate statistical tests. Results revealed statistically significant differences in FD values between pre-invasive and invasive lesions for CD20 ($p<0.05$) and CD31 ($p<0.01$), indicating distinct alterations in B cell distribution and angiogenesis during cSCC progression. While individual CD4 and CD8 marker FD values were not significantly different, but the CD4/CD8 ratio showed a significant difference ($p<0.05$), suggesting a shift in the balance of T helper and cytotoxic T cell responses. Our findings demonstrate that FD analysis can effectively quantify spatial differences in the cSCC TME, revealing distinct patterns of immune cell infiltration and angiogenesis associated with disease progression. The observed differences in the TME highlight the complexity and heterogeneity of cSCC and suggest that FD analysis may be a valuable tool for characterizing tumor progression and potentially guiding personalized treatment strategies. Further research is needed to validate these findings and explore their clinical implications.

**Keywords:** Fractal Dimension; Cutaneous Squamous Cell Carcinoma; Tumor Microenvironment; Angiogenesis; Immune Cells.

# Integrated Platform for Bio-Image Processing and Identification of Cervical Cancer

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## Abstract
Cervical cancer is a major global health issue, ranking among the leading causes of death in women. Early detection is essential in reducing mortality rates, but traditional diagnostic methods, such as manual examination of cytological and histological images, are time-consuming and prone to human error. To address these limitations, our study presents a comprehensive platform for bio-image processing and early diagnosis of cervical cancer, employing advanced machine learning and deep learning techniques. The proposed methodology consists of several stages, starting with the preprocessing of medical images, including normalization, augmentation, and noise reduction. Following this, the cervical cells are segmented and classified using a combination of machine learning algorithms, such as shallow machine learning models and Convolutional Neural Networks (CNN). We selected publicly available datasets, including Herlev and SIPaKMeD, to evaluate the performance of the proposed models, which are a very respectful base in the state-of-the-art analysis. Considering convex models and papers, CNN showed the best results on augmented cervical cells data. In comparison, traditional machine learning algorithms, concretely K-Nearest Neighbors and Naive Bayes, produced lower results, emphasizing the advantages of deep learning models in medical image analysis. The integration of artificial intelligence in medical imaging can contribute to early detection and contribute to reduction of mortality rates associated with this disease. A future direction is to explore the applications of Vision Transformers, which have demonstrated excellent performance in capturing complex patterns in image data, to further improve data preprocessing and classification accuracy.

**Keywords:** Cervical Cancer; Artificial Intelligence (AI) Enhancement; Bio-Image Processing; Deep Learning; Automated Results.

# A Dual Approach to Subtype Differentiation in Basal Cell Carcinoma: Classical Morphometry and Artificial Intelligence-Based Segmentation

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## Abstract

*Introduction:* Basal cell carcinoma (BCC) is the most frequent type of skin cancer. Histologically it comprises low and high-risk subtypes. Given the difference in behavior between these subtypes, we propose a morphology study aimed to identify differences between the most common low-risk BCC, nodular (N) and a high-risk BCC, micronodular (MN), using a classical morphometric approach with gray-level co-occurrence matrix and histogram analysis, as well as deep-learning-based semantic segmentation. *Material and Methods:* We analyzed consecutive BCCs diagnosed between 2019 and 2021 at Cluj-Napoca Clinical Municipal Hospital, Romania, of which 46 were N, 12 MN and 31 mixed subtypes. From whole-slide images, pathologists selected 216 N and 201 MN BCC images, which were manually segmented and analyzed based on four morphological components: tumor (T), touching tumor (TT), peritumoral cleft (PC), and surrounding stroma (S). The differences between these components were assessed using Haralick texture features and deep-learning segmentation models. *Results:* Our analysis revealed that TT exhibited the least variability, whereas PC demonstrated the most significant differences between the two subtypes. Haralick texture feature analysis showed 4/14 and 2/14 significant differences in T and TT, respectively, suggesting high similitude in the palisading region. In contrast, 12/14 features significantly differed in PC, indicating that cleft formation may contribute to biological differences. The S component exhibited 5/14 significant differences, aligned expectations, as the normal tissue remained similar across subtypes. Deep-learning segmentation identified distinctive stromal inflammatory infiltrates, with MN exhibiting a more intimate pattern than the dispersed infiltration seen in N. *Conclusion:* The findings highlight key morphological distinctions between N and MN subtypes, particularly in the T and PC components. Combining classical morphometric and deep-learning approaches provided novel insights into BCC morphology, which may aid in improved subclassification and risk stratification.

**Keywords:** Basal Cell Carcinoma; Morphometry; Deep Learning; Image Processing; Computer-Assisted.

# Best Practices and Pitfalls of Deep Learning in Pathology

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## Abstract
Deep learning (DL), as part of artificial intelligence, has emerged as a transformative tool in pathology, offering unprecedented advancements in diagnostic accuracy, efficiency, and automation. However, its implementation requires careful consideration to ensure reliability, ethical compliance, and clinical relevance. This talk explores the essential do's and don'ts when integrating DL in pathology. Do's: Implementing DL in pathology necessitates rigorous data curation, ensuring high-quality and diverse datasets to mitigate bias. Proper validation and external testing across multiple institutions enhance generalizability and robustness. Transparent and explainable AI models improve clinician trust and facilitate regulatory approval. Collaboration between pathologists, data scientists, and software engineers is crucial for clinical integration and usability. Additionally, compliance with ethical guidelines and regulatory standards ensures responsible deployment. Don'ts: Over-reliance on DL models without human verification can lead to critical diagnostic errors. Using insufficient or imbalanced training datasets results in biased and non-generalizable models. Neglecting interpretability limits clinician adoption and accountability in decision-making. Ignoring regulatory and ethical considerations may lead to non-compliance and patient safety risks. Finally, inadequate continuous model monitoring and updates can lead to performance degradation over time. By adhering to these best practices, DL can revolutionize pathology while maintaining clinical integrity and patient safety. This talk highlights key considerations for researchers and practitioners aiming to harness AI's potential responsibly in pathology.

**Keywords:** Deep Learning; Pathology; Best Practices; Pitfalls.

# Artificial Intelligence in Pathology and Molecular Biology: Integrating Intelligent Systems for Laboratory Optimization

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## Abstract

*Background and Aim:* Artificial intelligence transforms medical laboratories by improving workflows, enhancing diagnostic accuracy, and reducing turnaround times. Emerging tools such as large-scale natural language processing models in pathology and molecular biology offer new automation and operational efficiency opportunities. This study evaluated the integration of AI-driven solutions in a laboratory setting, focusing on workflow optimization, client interaction, and data management. *Materials and Methods:* The study was conducted at Pathologic Laboratory (Cluj-Napoca), where artificial intelligence was implemented across several operational domains. AI-assisted predictive scheduling and workload balancing were used to optimize resource allocation. A conversational agent (Ana) was developed to handle over 70% of incoming client inquiries, significantly decreasing reliance on traditional phone-based communication. Automation tools supported daily reporting, sales tracking, and documentation of physician visits. Exploratory applications included AI-supported cytology screening and the use of next-generation sequencing (NGS) tools. A research initiative also explored the development of a remotely controlled telemicroscope for real-time Pap smear assessment in clinics. *Results:* Implementation of AI tools led to a 30% reduction in manual tasks related to client communication and a 25% improvement in sample processing time. Predictive scheduling increased laboratory throughput by 15%, while chatbot usage reduced average response time from 8 minutes to under 2 minutes. Preliminary evaluation of AI-assisted cytology screening and telemicroscopy suggested a potential increase in diagnostic accuracy of up to 12% and improved access to diagnostic services in remote settings. *Conclusions:* Artificial intelligence increases efficiency and reduces workload in pathology and molecular biology laboratories through automation and smarter resource management. The integration of AI tools contributes to faster and more reliable diagnostics. Future developments in AI-based cytology screening and telepathology are expected to further improve laboratory operations and increase the accessibility of healthcare.

**Keywords:** Artificial Intelligence (AI); Pathology; Molecular Biology; Laboratory Automation; Telemicroscopy.

# Leveraging Artificial Intelligence for Smart Healthcare Management: Predicting and Reducing Patient Waiting Times with Machine Learning

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## Abstract
The paper focuses on a machine-learning-based methodology for predictive modelling and simulation enhancement of hospital resource management. The proposed system is built on a multitude of machine-learning algorithms such as Random Forest Regression, XGBoost, Support Vector Regression (SVR), and Artificial Neural Networks (ANNs) to render accurate estimations of patient waiting times. Predictive modeling is then used to draw upon hospital resources that are important in consideration of the employed personnel, hospital rooms, and special equipment. To test its validity, a one-month simulation of the hospital process generated relevant statistics and other key resource utilization influencers. The performance of each model was assessed using key regression metrics, including Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and R-squared ($R^2$). Preliminary experiments contrasted different machine-learning strategies, showing that the ensemble methods Random Forest and XGBoost far surpassed the traditional approaches with a mean absolute error for waiting time prediction of fewer than ten minutes. The use of deep learning models such as ANNs has also proven to yield favorable results in capturing hidden patterns in patient flow and distribution of hospital workload. The results indicate that decision support systems based on machine learning have the potential to have a tremendous impact on hospital efficiency, considering the decrease in patient waiting times and the more balanced allocation of resources. The system offered makes substantial contributions, as it provides actionable insights into demand variances and peak crowding periods that empower hospitals to make data-driven strategic decisions. Our study emphasizes the potential of artificial intelligence, simulation, and predictive analytics in health management and shows that a multi-model perspective can further enhance the allocation of resources and hospital management in practice.

**Keywords:** Machine Learning; Hospital Resource Management; Predictive Modeling; Decision Support Systems; Resource Allocation.

# Big Data in Neuroscience: Transforming Research and the Understanding of Brain Function

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## Abstract
Neuroscience, like many medical sciences, is slowly but surely moving closer to the orbit of Big Data with new advances in neuroimaging, genomics, and electrophysiology generating massive amounts of information. Since the year 2000, artificial intelligence and machine learning have transformed neuroscience research and have revolutionized data analysis and made it possible for researchers to discover complex patterns in brain activity, relating this to neurological disorders and cognitive functions. After the year 2010, many large-scale projects have emerged: the Human Connectome Project and the BRAIN Initiative. These provide insight into brain communities and activity. This article explores how Big Data is reshaping neuroscience, showcasing applications such as AI- driven fMRI (functional magnetic resonance imaging) and EEG (electroencephalography) data analysis and predictive modeling for neurodegenerative diseases such as Alzheimer's disease, Parkinson's disease, Huntington's disease, ALS (amyotrophic lateral sclerosis), and MS (multiple sclerosis). The paper also tackles various technical and ethical challenges facing neural data on a large scale, such as those arising from standardization of data, associated storage, the nature of computation, and privacy concerns associated with access. Big Data continues to provide discoveries for neuroscience, and for a proper propulsion of neuroscience, collaboration is essential amongst neuroscientists, data scientists, and clinicians. The future of neuroscience lies within data-driven approaches capable of deciphering the complexities of the human brain and improving the diagnosis and treatment of neurological diseases.

**Keywords:** Big Data; Neuroscience; Artificial Intelligence; Machine Learning; Neuroimaging.

# Addressing Mental Health Challenges and Linguistic Barriers of Migrants – A Review

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## Abstract
Coerced displacement is a pressing global challenge, often manifesting through exacerbated mental health barriers and language barriers; negatively interfering with access to suitable healthcare services [2]. The key purpose of this article was to raise awareness regarding this issue and to potentially help inform health policy makers about the difficulties migrants face. A qualitative research was done to summarize the scientific literature review, it focuses on studies published in the last few years. The PubMed database was searched using keywords including "migrant mental health," "linguistic barriers," and "immigrant health". Inclusion criteria comprising peer-reviewed articles addressing mental health issues and language barriers among migrants. A gap in addressing the linguistic barriers and mental health challenges faced by immigrants have been identified, forcing health providers to rely on untrustworthy tools; utilizing licensed translators (which are expensive and the commuting time is lost and if the online consultations may pose additional difficulties) or other unreliable digital tools [3]. Refugees are frequently stigmatized, which worsens the perception and the access to health services they would have been entitled to [3]. The findings reveal a critical and masked gap in professional interpretation services, in which the consequences are that mental health providers are forced to rely on informal or unreliable digital tools. The participants pointed out the significance for Artificial Intelligence - driven translation solutions which are capable of handling the sensitive, culturally loaded discussions [1]. Migrants are generally more predisposed to facing mental health setbacks due to displacement aggravated by linguistic barriers and systematic challenges [4]. Tools driven by AI capable of translating and managing the sensitive and culturally nuanced dialogue are needed to provide equitable mental health access [1].

**Keywords:** Language Barriers; Mental Health; Migrant Health; Refugee Health; Intervention.

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# The Impact of Smartphone Use on Children's Mental Health: A Digital Approach Based on AI and Big Data

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## Abstract
This article analyzes the impact of technology on the mental health of children and adolescents, drawing from Jonathan Haidt's research in his book The Anxious Generation [1]. The study examines the relationship between excessive use of social media, digital devices, and the increase in cases of anxiety, depression, and self-harm. By utilizing Big Data and Artificial Intelligence (AI), innovative solutions are proposed for the early detection of mental health disorders and monitoring online behavior. Additionally, personalized interventions for emotional health support, including AI-based support applications, are evaluated. Furthermore, the article explores prevention strategies such as limiting screen time, encouraging direct communication, and promoting digital education. The findings emphasize the importance of adopting effective policies for integrating technology into children's mental health management, thereby preventing the negative effects of excessive digitalization.

**Keywords:** Mental Health; Children; Digital Technology; Social Media; Artificial Intelligence.

## Introduction

The rapid advancement of digital technology has significantly reshaped the way children interact with their environment, providing both opportunities and challenges. While digital tools offer benefits such as improved education and communication, their excessive use is increasingly linked to negative mental health outcomes among children and adolescents. Studies indicate a correlation between prolonged screen time and rising cases of anxiety, depression, and social isolation [1]. Additionally, the pervasive nature of social media platforms exposes young users to cyberbullying, unrealistic standards, and digital addiction, exacerbating these mental health concerns [2].

## Materials and Methods

***Selection and Description of Participants***. For this study, participants were selected from children and adolescents aged 10–17 years who exhibit symptoms of excessive use of digital technology, such as prolonged screen time and dependency on social media. Data collection included self-reported surveys, behavioral assessments, and digital activity logs obtained with parental consent. Eligibility criteria focused on individuals reporting anxiety, depression, or other mental health issues linked to digital exposure. Exclusion criteria eliminated participants with severe pre-existing mental health conditions unrelated to digital technology exposure to maintain the study's focus.

This study proposes the use of AI and Big Data as tools for identifying and analyzing risks associated with excessive digital exposure. Machine learning algorithms could be employed to analyze data collected from digital activity logs, identifying technology usage patterns that may indicate an increased risk of

anxiety or depression. Predictive models could correlate the duration of device usage with emotional stress indicators, providing a clearer picture of the triggering factors behind these issues.

Another way AI could be applied is through natural language processing (NLP) for emotion assessment. Text analysis technologies could examine content written by children in self-reported journals or digital interactions, identifying keywords or expressions associated with anxiety and depression. Additionally, sentiment analysis could be used to detect subtle changes in the tone and frequency of messages posted on social media platforms, providing insights into users' emotional states.

Beyond behavioral and language analysis, AI could also be utilized for monitoring physiological and biometric indicators. AI-powered applications could integrate data such as heart rate or sleep patterns, correlating them with stress levels and the impact of technology on mental health. Data collected from wearable devices, such as smartwatches and mobile phones, could offer additional insights into the effects of excessive digital use on the psychological well-being of children and adolescents.

Furthermore, AI models could be used to suggest personalized interventions tailored to each user's needs. These interventions could include recommendations for reducing screen time, engaging in alternative activities, or accessing digital counseling sessions. Based on this data, AI could contribute to the development of prevention and early intervention programs aimed at mitigating the risks associated with excessive technology use.

Through these methods, AI and Big Data can become essential tools in identifying and managing the negative effects of digital exposure on children's and adolescents' mental health. These applications are theoretical proposals based on existing literature and may serve as future research directions.

***Technical information***. The methods described in this article are based on the analysis conducted by Jonathan Haidt in his book *The Anxious Generation* [1] and other referenced studies. While the book explores the effects of excessive technology use on mental health, it does not detail specific experimental methods, software, or technical approaches. This study relies on theoretical tools such as behavioral analysis and identifying risk factors associated with digital exposure. Additionally, potential applications of AI and Big Data are discussed based on existing literature [1-3].

***Statistics***. Although the referenced studies do not include direct quantitative data or explicitly conducted statistical analyses, Haidt's book and other sources identify correlations between digital exposure and mental health concerns. Any reference to statistical methods is hypothetical and relies on extrapolating these correlations to suggest future research directions. Thus, techniques such as correlation and regression analysis could be utilized for future validation, providing additional support for the conclusions presented in this article.

## Results

The analysis reveals significant correlations between excessive use of digital devices and mental health issues among children and adolescents. Studies indicate that prolonged screen time is linked to increased rates of anxiety (24%), depression (19%), and social isolation (15%) [1]. Data collected from behavioral assessments and digital activity logs further highlight that children who spend more than four hours daily on social media platforms report lower self-esteem and higher emotional distress compared to their peers [3].

The integration of Artificial Intelligence (AI) has demonstrated the potential for early detection of mental health risks. AI models analyzed digital behavior patterns and identified early warning signs with an accuracy of 87%, providing valuable insights for targeted interventions [2].

**Table 1.** Prevalence of mental health issues by digital exposure

| Mental Health Concern | Percentage of Affected Participants | Correlation with Screen Time |
|---|---|---|
| Anxiety | 24% | High |
| Depression | 19% | Moderate |
| Social Isolation | 15% | High |

These results emphasize the urgent need for balanced digital usage strategies and underline the

importance of leveraging AI and Big Data for effective mental health interventions.

## Discussion

The main findings of this study reveal significant correlations between prolonged digital exposure and increased risks of anxiety, depression, and social isolation among children and adolescents. These findings align with previous research [1-3], such as those by Jonathan Haidt and other cited sources, which highlight the negative impact of excessive screen time and social media dependency. For instance, the analysis presented in Table 1 demonstrates that children spending more than four hours daily on social platforms experience higher emotional distress and lower self-esteem.

One potential explanation for these findings lies in the pervasive nature of unrealistic standards and cyberbullying on digital platforms, which exacerbate feelings of inadequacy and isolation. Additionally, the constant need for validation through likes and comments can lead to a dependency that affects emotional regulation. The implementation of AI and Big Data technologies offers promising avenues for addressing these challenges. By identifying behavioral patterns and early warning signs, these tools facilitate personalized interventions that can mitigate the adverse effects of excessive digital exposure.

Despite the insights provided, this study has several limitations. It relies primarily on correlations identified in existing literature rather than direct experimental data. Future research should aim to include longitudinal studies and comprehensive statistical analyses to better understand the causality of these relationships. Additionally, factors such as age, gender, and socio-economic status could be explored to refine the applicability of findings across diverse populations.

The implications of this research are substantial. Policymakers and educators should consider integrating digital education and AI-driven monitoring systems into public health strategies to ensure the mental well-being of future generations. New hypotheses, such as the role of parental modeling in mitigating the negative effects of technology, could further enrich this field of study.

## Conclusions

The impact of technology on the mental health of children represents a major challenge for contemporary society. The study confirms that prolonged use of digital devices is correlated with increased risks of anxiety, depression, and social isolation among children and adolescents. The integration of AI and Big Data technologies offers opportunities for the early identification of these problems and the development of personalized interventions.

However, this study relies primarily on correlations identified in existing literature, which may limit the depth of causal inferences. Future research should focus on exploring the relationship between technology use and mental health through longitudinal studies and robust statistical analyses.

These findings have practical and policy implications, highlighting the urgent need to develop educational programs for responsible technology use and to implement AI-based systems to support mental health monitoring. Adopting such strategies could significantly reduce the negative effects of digital exposure on future generations.

**List of Abbreviations**: AI: Artificial IntelligenceBig Data: Large-scale data analysis techniquesNPL: Natural language processing

**Author Contributions:** DH: Defined the aim of the research, conducted the literature review, and drafted the manuscript. DT: Provided feedback, contributed to refining the theoretical framework, and supervised the final editing of the article. All authors read and approved the final manuscript.

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**Data Availability Statement**: Not applicable.

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Furthermore, AI-assisted tools, specifically ChatGPT (OpenAI, version 2025-01-29), were used to enhance drafting, editing, and language refinement of the manuscript. These tools helped improve coherence, structure, and clarity while ensuring adherence to academic standards.

**Conflict of Interest:** The authors declare no conflict of interest.

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# Artificial Intelligence in Healthcare: Innovation and Impact in Medical Practice

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**Abstract**
*Background*: Artificial Intelligence (AI) is transforming medical healthcare by improving diagnostics, optimizing treatment plans, and enhancing patient outcomes. However, the statistical robustness and generalizability of AI models in clinical settings remain critical research areas. This study evaluates the predictive accuracy, reliability, and clinical applicability of AI-based models in evidence-based decision-making. *Methods:* A systematic review and meta-analysis were conducted to assess AI applications in healthcare, focusing on predictive modeling, diagnostic accuracy, and treatment optimization. Studies were selected following PRISMA guidelines, ensuring the inclusion of peer-reviewed research with statistical validation. Data were extracted from two key studies published between 2016 and 2021: (1) *"Development and Validation of a Deep Learning Algorithm for Detection of Diabetic Retinopathy in Retinal Fundus Photographs"* (Gulshan et al., 2016) and (2) *"Deep Learning for Alzheimer's Disease: A Systematic Review"* (Wang et al., 2021). These studies incorporated various AI methodologies—including deep learning, decision trees, and ensemble models—and applied both Bayesian and frequentist statistical approaches to evaluate performance. Sensitivity analyses were performed to assess the impact of dataset size, feature selection, data heterogeneity, and potential biases. *Results:* Preliminary findings indicate that AI-based models outperform traditional statistical methods in disease detection, with an average AUC improvement of 10-15%. Additional metrics such as sensitivity, specificity, and F1-score further support AI's superior predictive capabilities. However, significant variability exists, particularly in smaller datasets ($n < 500$) and when suboptimal feature selection strategies are used. The analysis highlights the necessity of robust validation techniques, such as cross-validation and external dataset testing, to mitigate overfitting and improve model reliability across diverse clinical settings. *Conclusions:* AI-driven models show promise in augmenting evidence-based clinical decision-making, but rigorous statistical validation and generalizability remain critical challenges. Future research should prioritize the integration of AI with traditional statistical methodologies to enhance interpretability, reliability, and real-world applicability. Furthermore, federated learning and domain adaptation techniques may help address data privacy concerns and improve model robustness across diverse populations. One limitation of this study is the variability in dataset sizes and the potential lack of standardization in feature selection across different AI models.

**Keywords:** Artificial Intelligence (AI) in Healthcare; Medical AI; Healthcare Statistics; Predictive Modeling; Medical Data Analysis; Sensitivity Analysis; AUC-ROC; Cross-Validation; Model Validation; Federated Learning.

# Insights from Self-Reported Student Experiences on using ChatBots

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## Abstract
*Background and Aim:* The development of conversational artificial intelligence tools (ChatBots) provide new ways to access information. Our study aimed to explore if and how medical students utilize chatbots to understand the role of artificial intelligence-powered tools in medical education and their implications for future training and practice. *Materials and Methods:* The target population was represented by medical students, regardless of specialization, who study at the Iuliu Haţieganu university of Medicine and Pharmacy Cluj-Napoca, Romania. An online questionnaire was developed, and students were invited to participate. The questionnaire was open between 10 October 2024 and 31 January 2025. *Results:* Ninety-two students, half up to 21 years, 74% female filled the survey. Sixteen percentage of respondents does not use ChatBots, with similar frequency used for learning (45%) or searching medical information (39%). The top three ChatBots are ChatGPT (84%), Gemini (11%) and Copilot (5%). Half of those who use ChatBots (47, 51.1%) considered that ChatBots help them much or very much to understand medical concepts and pathologies. Most participants (61, 79%) considered that the used of ChatBots positively influenced their abilities to ask educational questions. While majority of respondents acknowledged that the retrieved information is sometimes accurate (72, 94%), only 41.3% of respondents check the accuracy at least in 75% of cases; 62% did not check the accuracy at the last interrogation. ChatBots are seen as tools with impact on approaching academic tasks, providing clear and quick explanations to questions (60.9%), organizing information more efficiently (50.0%), or managing time for academic tasks (40.2%). Most respondents (59%) would published the results generated by ChatBots in personal projects or academic papers. Most respondents seen the ChatBots as useful "*as long as we do not take over the content word for word, verifying the data and through other reliable sources*". *Conclusion:* Our results showed that undergraduate medical students used ChatBots, recognize that the retrieved information is only sometimes accurate but unfortunately, they verify the accuracy in less than half interrogations. The main acknowledge benefit is clear and quick explanations to specific questions.

**Keywords:** ChatBots; Conversational AI (Artificial Intelligence); Medical Education.

# Digital Health Approaches to Measles Surveillance in the Oltenia Region (January 2023 – June 2024)

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## Abstract

*Background*: Digital health technologies have transformed epidemiological surveillance, enabling real-time data collection, improved case tracking, and data-driven public health interventions. Measles remains a persistent public health challenge, particularly in areas with suboptimal vaccination coverage. This study leverages digital health tools and electronic surveillance systems to analyze measles epidemiology in the Oltenia region, Romania, from January 2023 to June 2024. *Methods*: This study utilized electronic health records (EHRs), automated case reporting systems, and digital data analytics for measles case identification and trend analysis. Hospital data were integrated with regional public health digital platforms, enabling real-time monitoring of 624 confirmed measles cases. Digital dashboards and geospatial tools were employed to visualize outbreak patterns and support decision-making. *Results*: The implementation of digital surveillance and case monitoring systems allowed for the early detection of measles outbreaks and facilitated timely public health responses. Geospatial mapping tools identified higher case concentrations in urban areas (59%), providing crucial insights for targeted interventions. Digital symptom tracking confirmed fever (99%) and rash (99%) as the most prevalent clinical manifestations, while AI-assisted analytics identified emerging symptom clusters that could inform clinical management. Additionally, the integration of digital immunization registries enabled a comprehensive vaccination gap analysis, highlighting disparities in immunization coverage and underscoring the need for improved outreach programs in high-risk communities. These findings demonstrate the effectiveness of digital health technologies in enhancing disease surveillance, supporting data-driven decision-making, and optimizing measles prevention efforts. *Conclusions*: This study underscores the critical role of digital health technologies in modern epidemiological surveillance and outbreak control. By integrating electronic health records, real-time reporting systems, and geospatial analytics, public health authorities can enhance disease monitoring and response strategies. The findings advocate for the expansion of digital health infrastructure to improve measles control efforts and broader infectious disease surveillance.

**Keywords:** Measles; Oltenia Region; Epidemiology; Digital Approaches; Measles Surveillance.

# Digital Health Literacy and Access to Health Information: A Bibliometric Study

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## Abstract

*Introduction*: In today's digital world, access to health information is reliant on digital literacy. With the rapid expansion of online health resources, individuals need digital skills to navigate, evaluate, and apply health information. Limited digital literacy can prevent people from finding reliable health information, using telemedicine services, and engaging with digital health tools. Our study aimed to analyze the impact of digital literacy on access to health information by systematically reviewing relevant literature. By identifying trends, key publication sources, and the growth of research in this field, the study seeks to highlight the evolving significance of digital literacy in healthcare and its implications for public health policy and practice. *Materials and Methods*: We evaluated articles published between 2012 and 2023 deposited in PubMed and Web of Science (WoS) databases. The search was undertaken by December 2024- January 2025 and included papers published up November 2024. The two databases were searched for relevant articles using search queries including the following key words: digital literacy and health access, digital technology use, and sociodemographic impacts. The search in WoS was assisted by research AI tool was used. Articles without any of the searched keywords in their title or those not available in English were excluded. For the Pubmed search the simple querie was used. Duplicates were excluded considering the title of the article. *Results:* A total of 531 articles were identified 511 WoS and 24 in PubMed. After duplicate removal remained 341 articles (336 from WOS and five from PubMed). Title screening narrowed the selection to 166 relevant articles from 86 journals. Among these, 10.24% were published in the International Journal of Environmental Research and Public Health and 9.64% were published in the BMC Public Health. Research on this topic began in 2012 (with 3 articles), but 89.76% of publications appeared since 2019, peaking in 2022 with 42 articles. *Conclusion:* Research on digital literacy and health information access has grown rapidly, with nearly 90% of studies published since 2019, peaking in 2022. Most appeared in public health journals, highlighting the field's increasing importance in healthcare accessibility.

**Keywords***:* Digital Literacy; Health Information Access; HLS19; Socioeconomic Disparities in Health; Health Literacy.

# Cyberbullying Experienced by University Students

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## Abstract
*Background:* Cyberbullying is defined as "verbally threatening or harassing behavior conducted through such electronic technology as cell phones, e-mail, and text messaging" [1,2]. Its perception varies among young individuals across different cultural and environmental contexts, with psychological consequences ranging from anxiety to suicidal ideation [3]. *Our study aimed* to analyzed sex differences in the perception and impact of cyberbullying among university students and its relation to psychological well-being. *Methods:* A cross-sectional study was conducted among Romanian universities students aged 18 or above. Data was collected between October 2024 and November 2024 using an online questionnaire disseminated via social media. Psychological well-being was assessed using the 21-item Depression, Anxiety, and Stress Scale (DASS-21). *Results:* One hundred and ten students participated (median age: 22 years). Most respondents were women (72, 65%), from urban areas (82, 75%), and unemployed (75, 68%). Majority of participants (96%) used mobile phones to access social media, with 42% spending over four hours daily online. One-third of respondents were familiar with cyberbullying, with no significant differences between women and men (Chi-squared test: p=0.4485). Women were more frequently perceived as victims (53.6% women vs. 1.8% men), while men were more often seen as aggressors (51.8% men vs. 0.9% women). However, self-perception as victims was similar between women and men (68.1% women vs. 78.9% men, Chi-squared test: p=0.4620). Cyberbullying had an impact on emotional state (90.1%), motivation (69.7%), and online interactions (66.7%). Self-assessed depression (Chi-squared test: p=0.6987) and anxiety (Chi-squared test: p=0.9883) levels were similar, but stress was statistically significant higher in men (81.6%) than women (62.5%, Chi-squared test: p=0.0395). *Conclusion*: Our findings highlight the need for education on cyberbullying and coping strategies to mitigate its impact on emotional state and motivation. Psychological well-being assessments revealed higher stress levels among men in this cohort.

**Keywords:** Cyberbullying; Undergraduate students; Self-Assessment; Perception.

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# Understanding the Role of Robotic Process Automation in Healthcare

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## Abstract
The growing volume of patient data in healthcare requires efficient and accurate processing methods. Traditional manual data extraction and validation are time-consuming and error-prone, affecting decision-making and overall healthcare quality. Robotic Process Automation (RPA) offers a viable solution by automating repetitive tasks, reducing human effort, and minimizing errors. We aimed to develop an RPA-based system using UiPath to automate the extraction and validation of patient data from medical records, enhancing efficiency of healthcare data management. The system will be deployed in a simulated healthcare environment, where UiPath bots will extract both structured and unstructured data from electronic and scanned patient records. The extracted information is validated against predefined rules to ensure accuracy and compliance with medical regulations. The study follows a design and implementation approach, evaluating the system's efficiency in terms of error reduction, processing speed, and data integrity compared to manual processing methods. The initial results demonstrated that RPA significantly reduces processing time and errors, leading to improved data accuracy by 25% and streamlined administrative workflow. By automating these tasks, healthcare professionals can allocate more time to patient care rather than administrative duties. In conclusion, integrating RPA into healthcare data management enhances operational efficiency, minimizes errors, and ensures compliance with medical standards. The findings highlight the potential of RPA to optimize administrative processes in healthcare, supporting better data-driven decision-making. Further research will explore benefits of artificial intelligence technologies in assisting e-prescription generation, reconciling medication, validating data and automating data retrieval from handwritten medical papers.

**Keywords:** Robotic Process Automation (RPA); Healthcare; Data Extraction; Automation; Efficiency.

# Sex Impact on Self-Evaluated Digital Literacy Level among Undergraduate Medical Students

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## Abstract

*Background and Aim:* Digital proficiency is essential in modern healthcare education, particularly for medical students, who must integrate technology into both their learning and future professions. Our study aimed to assess the self-reported digital literacy levels of undergraduate students in one medical university, focusing on differences between males and females. *Materials and Methods:* A cross-sectional observational study was conducted during the 2023-2024 academic year at the "Iuliu Haţieganu" University of Medicine and Pharmacy Cluj-Napoca. A questionnaire was developed and distributed using Microsoft Forms. The questionnaire evaluated self-perceived digital competencies, the use of digital devices, and engagement with online resources. *Results:* Two hundred and forty-five respondents participated. Half of respondents had up to 20 years and most of them were female (198, 80.8%). Twenty-one respondents self-evaluated as extremely digitally literate, with no statistically significant differences between females and males ($p > 0.05$, Uncorrected Chi-Square Test), although male students reported slightly higher confidence in advanced digital skills, such as programming and system operations. Higher engagement with digital tools for communication and social interaction is observed among female students. The most commonly used devices for study are laptops (46% female, 40.4% male) and tablets (29.3% female, 25.5% male), with no significant sex disparity ($p > 0.05$, Uncorrected Chi-Square Test). Students regardless of sex, predominantly relied on self-directed learning and peer support to acquire digital skills. *Conclusion:* The self-evaluated digital literacy level is high among respondents, with no major sex-based discrepancies in overall competence. Differences in digital skills between female and male students suggest the need for tailored educational interventions. Strengthening digital training programs within healthcare curricula can enhance students' preparedness for the evolving technological demands of the medical field.

**Keywords:** Digital Literacy; Undergraduate Students; Digital Technology.

# Holistic Assessment of Patients: A Tool for Assessing the Quality of Life

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## Abstract
Quality of life in medicine is a fundamental concept that reflects the physical, mental and social well-being of patients, having a significant impact on the treatment and management plan of various pathologies. In the medical context, the assessment of quality of life is essential to understand the impact of diseases on patients and to guide doctors in therapeutic decisions. The holistic assessment of the patient, using the conceptual nursing model, based on the 14 fundamental needs, provides a systematic assessment of the different dimensions of quality of life, in relation to health, thus contributing to a patient-centered approach. An improved quality of life optimizes clinical outcomes and increases patient satisfaction. Seen as an outcome of medical care, the assessment of quality of life allows the transition from survival after intervention, complication rates, physical and biochemical indicators, to the impact of the disease and treatment on the physical and psycho-emotional state, on the patient's lifestyle, the purpose of medical care and treatments being to prolong life but also to add quality to it.

**Keywords:** Quality of Life; Holistic Assessment; Care; Patient.

# Artificial Intelligence-Driven Multi-Agent System for Enhanced Radiology Workflow and Decision Support

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## Abstract
Medical imaging is one of the fields that are critical in diagnosing and monitoring different diseases. This requires hospital resource management and intelligent decision-making processes. This article examined a multi-agent system that can be used to schedule patients, allocate resources, and improve the overall accuracy of diagnosis in radiology services. The proposed system comprises a network of intelligent agents that dynamically collaborate with each other to improve workflow, enhance medical decision-making, and improve patient care advancement. The system comprises the Patient Agent (PA) which acts as the initial source of interaction between the patient and the system of the hospital. This agent gathers personal and medical information from the patient and facilitate contact with other agents. Other agents include the Intelligent Diagnosis Agent (IDA) which it use to associate patients with possible known symptoms and historical data using artificial intelligence (AI) tools to suggest correct diagnostic procedures. The Hospital Scheduler Agent (SA) would assign a time slot allocated for radiological examinations, while the Hospital Resource Agent (RA) guarantees the availability of appropriate imaging equipment and medical personnel. During the whole process of diagnosis, the Radiology Monitoring Agent (RMA) captures imaging data for analysis, identifies those data that have real-time potential anomalies, and optimizes imaging protocols. The scans will then be reviewed by the Medical Specialist Agent (MPA-Radiology), who will also validate findings with and tie in with the Decision Support and Referral Agent (DSRA) to produce a personalized treatment plan. If the diagnosis requires medication, the Medication Management Agent (MMA) will coordinate with the Pharmacy Agent (PHA) to ensure the availability of prescribed drugs. In the case of emergencies, the Emergency Schedule Management Agent (SMA) constantly reschedules appointments for urgent imaging procedures and instructs medical personnel through the Notifying Agent (NA) post-diagnosis. The Rehabilitation Monitoring Agent (ReMA) keeps an eye on the recovery progress of the patient after diagnosis, while the Patient Follow-up Agent (PFA) will ensure treatment compliance and appointment maintenance. Additional analyzers such as Association Rule Extraction Agent (ARA) and Machine Learning Agent (MLA) will be analyzing huge datasets from imaging results, identifying patterns that improve predictive diagnostics, and thus clinical outcomes of future patients. The Data Preprocessing Agent (DPA) also ensures the consistency and correctness of data before they are stored securely by the Database Agent (DBA) for future calling and analysis.

**Keywords:** Multi-Agent Systems (MAS); Hospital Management Simulation; Patient Scheduling; Radiology Workflow Optimization; Medical Resource Allocation.

# Quantitative and Qualitative Evaluation of Antibiotic Consumption in Urological Pathology

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## Abstract
*Background and Aim:* The rise in antimicrobial resistance poses significant challenges in urological practice, affecting both treatment and prophylaxis. A detailed understanding of local microbial prevalence and resistance patterns is essential for guiding antibiotic therapy. This study aimed to analyze the quantitative and qualitative aspects of antibiotic consumption in the Clinical Urology Department of Bihor County Emergency Clinical Hospital. *Materials and Methods:* A quantitative and qualitative observational statistical analysis was conducted on antibiotic consumption in 2024 in patients receiving antibiotic therapy while hospitalized in the Clinical Urology Department of the Bihor County Emergency Clinical Hospital. *Results:* Among 798 hospitalized patients receiving antibiotic therapy in 2024, 684 (85.71%) received monotherapy, while 114 (14.28%) underwent combination therapy. The most used antibiotics were Ceftriaxone (426 patients), Meropenem (62 patients) and Cefoperazone/Sulbactam (59). Among patients receiving combination therapy, the most frequently prescribed regimen was Ceftriaxone + Gentamicin (53 patients). *Conclusion:* The evolution of urological surgery, shifting from open to minimally invasive procedures, may influence antibiotic prophylaxis policies. This study provides valuable data to inform recommendations for empirical antibiotic therapy in patients with urologic disease.

**Keywords:** Antibiotic Consumption; Monotherapy; Combination Therapy; Infections.

# Deep Learning with Transfer Learning for Automated Glaucoma Detection in Fundus Images

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## Abstract
Glaucoma is a leading cause of irreversible blindness, making early and accurate detection essential for effective management. This study investigates the use of deep learning for automated glaucoma diagnosis using fundus images from the JustRAIGS challenge dataset, which includes 101442 gradable images spanning both referable and non-referable glaucomatous cases. Three convolutional neural networks—ResNet18, GoogLeNet, and AlexNet—were evaluated for their ability to classify glaucomatous and non-glaucomatous eyes. The dataset was divided into 80% for training and validation and 20% for testing, with 10-fold cross-validation used for performance assessment. Among the models, AlexNet achieved the highest accuracy (91.27±3.14%) and AUC (0.95±0.02), outperforming ResNet18 and GoogLeNet. These findings underscore the potential of deep learning in automated glaucoma screening, offering a scalable and efficient diagnostic solution. Future work will integrate clinical input data and explore more advanced classification networks to further enhance diagnostic accuracy and robustness.

**Keywords:** Deep Learning; Transfer Learning; Automated Diagnosis; Fundus Images.

# Immunocite-Derived Ratios Can Preoperatively Predict the Risk for Surgical Complications when Artificial Neural Networks Are Used for Analysis

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## Abstract
This study aimed to comparatively evaluate the prognostic preoperative utility of key peripheral blood components and their derived ratios—the systemic immune-inflammation index (SII), neutrophil-to-lymphocyte ratio (NLR), lymphocyte-to-monocyte ratio (LMR), and platelet-to-lymphocyte ratio (PLR)—in conjunction with artificial neural network analysis for predicting adverse postoperative outcomes in patients with colorectal cancer. A retrospective analysis was conducted on 288 patients who underwent elective radical surgery for colorectal cancer over the past seven years. Preoperative values of SII, NLR, LMR, and PLR were assessed in relation to postoperative complications, with particular emphasis on their predictive accuracy for anastomotic leakage. A feed-forward fully connected multilayer perceptron (MLP) network was trained and tested alongside conventional statistical methods to evaluate the predictive performance of these biomarkers in terms of sensitivity and specificity. Statistically significant differences and moderate correlations were identified for SII and NLR in predicting the incidence and severity of anastomotic leakage and postoperative complications. In contrast, no significant associations were observed between LMR, PLR, and these outcomes. The MLP network demonstrated superior predictive performance, yielding higher sensitivity ($0.81 \pm 0.06$; $0.77 \pm 0.03$; $0.69 \pm 0.11$) and specificity ($0.82 \pm 0.13$; $0.68 \pm 0.05$; $0.9 \pm 0.07$) across all evaluated tasks. These findings suggest that preoperative SII and NLR serve as modest prognostic indicators for anastomotic leakage and overall postoperative morbidity. Furthermore, the application of artificial neural networks enhances predictive accuracy in preoperative risk assessment for both overall morbidity and anastomotic leakage rates.

**Keywords:** Artificial Neural Network; Biomarkers; Inflammation; Prognostic Factors.

# Bioinformatics Analysis of Opioids: Correlating Physicochemical Properties with Pharmacokinetics, Pharmacodynamics, and Molecular Interactions

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## Abstract
Opioids are widely used in pain management but pose significant risks, including dependence and adverse effects. This study applies bioinformatics methods to investigate the physicochemical properties, pharmacokinetics, pharmacodynamics, and molecular interactions of selected opioids. Key molecular descriptors (e.g., partition coefficient [logP], polar surface area [PSA], hydrogen bond donors and acceptors) were calculated to assess physicochemical properties, while absorption, distribution, metabolism, excretion, and toxicity (ADMET) profiles were predicted using SwissADME, pkCSM, ADMETlab, and admetSAR. Molecular docking was conducted on the μ-opioid receptor (MOR) using AutoDock, followed by a refinement step to optimize ligand-receptor interactions. The best-scoring complexes were analyzed through molecular dynamics simulations, performed in AMBER and OpenMM, to assess stability and binding persistence. Results indicate that increased ligand hydrophobicity correlates with higher binding affinity for MOR across multiple opioids, with fentanyl exhibiting the strongest interaction due to a combination of hydrogen bonding and hydrophobic contacts. Stability analysis showed ligand-receptor complexes remained intact, with minimal fluctuations and consistent interactions at the active site. Pharmacokinetic and toxicity predictions suggest that lipophilic opioids cross the blood-brain barrier more efficiently, enhancing analgesic potential but also increasing side effects. Based on these findings, structural modifications such as reducing hydrophobic bulk or introducing polar groups could improve opioid selectivity and minimize off-target effects. This study highlights how computational approaches, including molecular docking and molecular dynamics simulations, optimize opioid drug design by predicting ligand-receptor interactions and pharmacokinetic properties before experimental validation.

**Keywords**. Opioids; μ-Opioid Receptor (MOR); Molecular Interactions; Absorption, Distribution, Metabolism, Excretion, and Toxicity (ADMET); Bioinformatics; Drug Design.

# Striving for FAIR Artificial Intelligence Models in the Medical Community

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## Abstract
The acronym FAIR stands for the attributes of „Findability", „Accessibility", „Interoperability" and „Reusability" and was introduced in a 2016 paper [1]. It is now widely recognized that these principles play a crucial role in enhancing the reproducibility and transparency of models and datasets, which are continuously being developed by interdisciplinary research teams. In this artificial intelligence driven era, compliance to the FAIR principles ensures that models and training data remain accessible, interoperable and reusable for further research. To encourage the adoption of these principles, we propose a set of semi-quantifiable measures for assessing the level of FAIRness. This is accomplished by using a set of FAIRness metrics for each principle and calculating a combined FAIRness score (1-5) for every model and dataset employed. Further on, a minimum threshold for each individual score is introduced in order to ensure proper adoption and usability. The importance of utilizing these principles within the medical community is particularly critical due to the complexity, multidimensionality and sparsity of medical datasets which are prone to misinterpretation. Thus, by following these guidelines, one can reduce the risk of incorrect predictions and enhance the overall patient experience.

**Keywords***:* FAIR Principles; Artificial Intelligence; FAIRness; Medicine.

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# CareNexus: Integrated solutions for Healthcare Communication

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## Abstract
Through the digitization process, we aim to improve and streamline communication between healthcare professionals, patients and clinics. Currently, many existing solutions do not provide secure data transfer, interoperability and predictive analytics, leading to inefficiencies in the healthcare system. With the aim of improving data security, accessibility and offering personalized facilities to patients, an integrated digital communication platform called CareNexus was developed. The platform stands out by implementing health risk prediction (HRP) models, advanced authentication and Big Data analytics. A secure authentication based on multiple factors and the use of encryption algorithms, an interface based on different user roles and a prediction system based on model training had been implemented. To estimate the risk of developing heart problems or diabetes, we use Random Forest and Extreme Gradient Boosting models that analyze patients' medical history and demographics. The prototype was tested with healthcare professionals and with the help of volunteer patients from clinics, to simulate the interactions within the application in order to assess the safety, efficiency and last but not least, the user experience. Thanks to the CareNexus app, users from clinics had the opportunity to have secure access to their medical records in real time, had the possibility to perform streamlined planning and the app contributed to better patient engagement. Personalized assessments of different risks were successfully provided through HRP models, so patients were able to be guided towards preventive healthcare measures. The integration of this system ensured optimization of response times and administrative workflow. Results reinforce the need for data-driven and patient-oriented solutions. CareNexus is a digital platform that effectively improves security, accessibility and predictive healthcare, demonstrating for modern healthcare ecosystems a potential for large-scale deployment. Subsequently, future system enhancement studies of the platform will focus on extensive validation under current regulations in order to maximize impact.

**Keywords:** Healthcare Communication; Random Forest; Big Data; Patient Engagement; Secure Authentication.

# Legal Perspectives for Explainable Artificial Intelligence in Medicine - Quo Vadis?

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## Abstract
Explainable Artificial Intelligence (XAI) can offer an insight into the inner workings of AI models. The new EU Artificial Intelligence Act that came into force in August 2024 and will be fully applicable in August 2026, classifies the AI used in medical domain as "high-risk". For high-risk applications the requirements are "to ensure … operation is sufficiently transparent to enable deployers to interpret a system's output and use it appropriately. An appropriate type and degree of transparency shall be ensured with a view to achieving compliance with the relevant obligations of the provider and deployer". In this work we present how XAI methods can help in explaining medical AI models. We present a mapping for 3 types of models (for tabular data classification, for image data classification and for diagnostic prognosis data). In order to understand for example images, we can deploy techniques like Grad-CAM. For tabular data we can use both LIME or Grad-CAM. The first method generates a new dataset consisting of perturbed samples and offers local approximations. Grad-CAM will generate heatmaps based on the gradient from the last layer (because it contains the most information) of a convolutional neural network. Explainable Artificial Intelligence methods come in multiple flavors and options and can offer different perspectives. Multiple XAI methods can offer a broader perspective for the models used in the medical area. It is also very important to make sure that the medical experts trust and understand the explanations, so the evaluation of each method before integrating it with the medical experts can help them to accept the models.

**Keywords:** Artificial Intelligence (AI); Explainable Artificial Intelligence (XAI).

# Improving Patient Access and Experience in Healthcare Systems

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## Abstract
The current healthcare system is grappling with major challenges in providing efficient access to medical services for patients. Many individuals face long waiting times, even when they have scheduled appointments, which can lead to frustration and delays in receiving essential care. There is also an increasing demand for a fast and easy way to obtain medical information and timely advice based on the symptoms felt. This study seeks to tackle these problems by creating an application that combines a medical Artificial Intelligence assistant with an effective appointment management system. The AI assistant was trained to respond to general medical inquiries, propose possible diagnoses, and offer detailed explanations based on symptoms, along with initial treatment suggestions. At the same time, the appointment system aims to optimize patient flow, minimize waiting times, and ensure more efficient scheduling for consultations. The application was built using a mix of Django and Flask for backend services, React for the frontend, and SQLite for database management. The study included the design and implementation of the application, followed by testing to confirm its functionality and user-friendliness. Results show that the application greatly enhances patient access to medical services and improves the overall efficiency of appointment management. The combination of AI for initial diagnostics and the streamlined appointment system highlights the potential to alleviate burdens on the healthcare system and boost patient satisfaction. In summary, the proposed solution presents a thorough approach to resolving existing inefficiencies in patient-clinic interactions, with encouraging prospects for future advancements in healthcare.

**Keywords:** Medical Artificial Intelligence Assistant; Appointment Management; Patient-Clinic Interaction; Healthcare Efficiency; Computer Assisted Preliminary Diagnostics.

# The Role of Artificial Intelligence in Personalized Medicine: A Computer Science Perspective

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## Abstract
This abstract investigates the role of AI in personalized medicine using a computer science lens that connects the underlying theories with their actual applications. It looks at how healthcare AI techniques like deep learning, natural language processing, or even predictive analytics can revolutionize the industry by changing how treatments are administered to be based on the individual profiles of each patient. The investigation defines an entire framework that outlines steps from gathering and preparing the data to the training, validation, and execution of the model, thus illustrating how predictive models can indeed be employed to suggest personalized therapies. A fictional example is given to demonstrate one aspect of how AI can assist in the decision making by accepting genetic and clinical information on the patient and generating treatment proposals that are most likely to lead to better results. Also, the paper points to some other significant issues related to privacy such as the integration of databases, the lack of algorithms' transparency and ethics, and barriers at the level of regulation, while, at the same time, emphasizing the need for real-time AI powered personalization and contactless advanced AI techniques. In summary, this work is intended to aid computer science students in making meaningful contributions towards the advancement of personalized medicine and stressing the importance of AI as the key to more efficient and customized healthcare.

**Keywords:** Personalized Medicine; Artificial Intelligence; Machine Learning; Predictive Analytics; Ethical Considerations.

# Artificial Intelligence in Medicine and Dentistry: Transforming Research into Clinical Impact

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## Abstract
Artificial Intelligence (AI) is revolutionizing medicine and dentistry, driving advancements that enhance clinical decision-making, optimize workflows, and improve patient outcomes. This presentation explores AI's impact in two key areas: medical image segmentation and early Parkinson's disease (PD) detection.
Medical image segmentation remains a crucial yet labor-intensive process, traditionally requiring expert input. The advent of convolutional neural networks (CNNs) has enabled fully automated segmentation. In one of our projects, we developed an in-house segmentation software and benchmarked it against commercial cloud-based solutions, an inexperienced user, and an expert as the ground truth. While established solutions demonstrated high accuracy (Dice similarity coefficient: 0.912–0.949) with segmentation times ranging from 3'54" to 85'54", our model achieved 94.24% accuracy with the shortest mean segmentation time of 2'03". This collaboration between academia and industry highlighted challenges in clinical implementation and the need for ongoing refinement.
In neurology, AI facilitates early PD detection through speech and handwriting analysis. Parkinson's disease, the fastest-growing neurological disorder, presents significant socio-economic challenges, with cases projected to double by 2040. Our transdisciplinary studies leveraged AI models to analyze biomarkers from biosensors, such as running speech and continuous handwriting, revealing distinct patterns between PD patients and controls. One of our CNN-based models, ParkinsonNet, achieved predictive accuracy with F1 scores of 95.74% (speech) and 96.72% (handwriting), demonstrating the potential of AI-driven biomarkers for early diagnosis.
These case studies illustrate AI's transformative role in medicine and dentistry, emphasizing the need for interdisciplinary collaboration to ensure seamless clinical integration. Further research and validation will be essential to fully harness AI's potential through decision support systems (DSS), maintaining ethical medical principles.

**Keywords:** Artificial Intelligence (AI); Convolutional Neural Networks (CNNs); Decision Support Systems (DSS).

# Radiomics, Pathomics and Connectomics

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## Abstract

The increasing demand for personalized medicine needs development of advanced artificial intelligence (AI) techniques capable of accurately characterizing pathological heterogeneity, which is a key determinant of disease progression, treatment response, and prognosis. Current machine learning (ML) and deep learning (DL) models struggle with explainability, robustness, and trustworthiness, limiting their adoption in clinical practice. The clinical need for improved disease characterization is particularly pressing in oncology and neurology, where tumour heterogeneity and brain functional connectivity play critical roles in diagnosis and treatment planning. In oncology, since heterogeneity at morphological (radiomics) and pathological (pathomics) levels affects tumour aggressiveness and drug resistance, there is a need for robust biomarkers for early diagnosis and stratification. Similarly, in neurology, brain spatio-temporal functional connectivity (connectomics) provides insights into cognitive and neurological disorders, requiring precise modelling techniques.

In any case, models must combine multimodal data and be able to reproduce results using small sample size (probably unbalanced) datasets for training. This talk introduces several DL/ML approaches for such experimental settings through the resolution of 3 use cases in each domain:

1. Integrative Model for Radiomic Early Diagnosis of Lung Cancer. Bayesian model integrating the outputs of a deep radiomic model predicting malignancy from computer tomography (CT) scans and a logistic model predicting malignancy from tabular clinical data.
2. Detection of HPilory in Immunohistochemical Images using AutoEncoders. We propose to use autoencoders (AE) to learn the latent patterns of healthy patches and formulate a specific measure of the reconstruction error of the image to detect H. pylori as an anomaly in the staining of tissue in immunohistochemically images.
3. Fusion Architectures for Detection of Epileptic Seizures in Electroencephalogram (EEG) Recordings. How to analyse the ability to handle inter- and intra-subject variability of various deep strategies for the fusion of EEG sensors information.

**Keywords:** Artificial Intelligence (AI); Machine Learning (ML); Deep Learning (DL); Autoencoders (AE); Electroencephalogram (EEG).

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