Harnessing Artificial Intelligence in Healthcare Education and Research: A Multifaceted Approach

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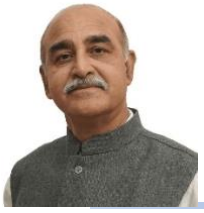

Forward

I am delighted to share the booklet, on **Harnessing Artificial Intelligence in Healthcare Education and Research: A Multifaceted Approach** with all of you. This booklet focuses on the core principles of AI and its significant impact on medical education.

In today's changing healthcare landscape Artificial Intelligence has become a force that reshapes how we approach medical education, research and patient care. This booklet serves as a guide offering an overview of AI basics while exploring its practical applications within the realm of medical education.

As we find ourselves at the crossroads of technology and healthcare it is crucial for medical professionals to possess an understanding of AI principles and applications. This booklet not only demystifies the complexities surrounding AI but also highlights its potential to enhance diagnostic precision, streamline administrative processes and ultimately improve patient outcomes.

The integration of AI into curricula is not merely a passing trend; it is a necessity. This booklet acts as a catalyst in fostering comprehension among educators, students and practitioners. By embracing AI in our pursuits we lay the groundwork for a future where healthcare becomes more precise, personalized and efficient.

I would also like to commend the noteworthy efforts of All India Institute of Medical Sciences, Rajkot in spearheading the integration of Artificial Intelligence into the realm of healthcare and medical education. AIIMS Rajkot has been at the forefront of leveraging AI technologies to research methodologies and educational practices. Starting with basics, the Academic Section along with AI team of AIIMS Rajkot has completed one-day in-house Hands-on workshop to train all faculties of the Institute on Artificial Intelligence. By actively engaging with cutting-edge AI applications, AIIMS Rajkot is contributing significantly to the evolution of medical practices and medical education, ensuring that both the present and future generations of healthcare professionals are well-equipped to navigate the complexities of an increasingly digitized healthcare landscape.

I would like to commend the efforts of the Academic Section along with AI team at AIIMS Rajkot, for assembling this resource. May this booklet serve as a catalyst, for conversations sparking curiosity and empowering the community to fully leverage the capabilities of Artificial Intelligence in pushing forward the boundaries of healthcare.

Wishing you all reading and ongoing achievements, in incorporating AI into medical education.

Prof. Dr. (Colonel) CDS Katoch
Executive Director and CEO,
AIIMS Rajkot

Embracing the Evolution - Integrating Artificial Intelligence in MBBS Undergraduate Education

In the dynamic landscape of healthcare, the convergence of technology and medicine has catalysed unprecedented advancements, steering the industry toward an era defined by innovation and efficiency. As the world progresses, the integration of Artificial Intelligence (AI) stands as a pivotal milestone in reshaping healthcare paradigms, revolutionizing diagnostics, treatment modalities, and patient care.

Recognizing the transformative potential of AI, the curriculum for MBBS undergraduate students undergoes an evolutionary enhancement, designed to equip future physicians with comprehensive knowledge and proficiency in leveraging AI-powered tools and methodologies. This visionary augmentation aims not only to fortify the conventional medical education framework but also to nurture a cohort of healthcare professional's adept at harnessing the capabilities of AI to enhance clinical decision-making, amplify diagnostic accuracy, streamline patient care, and augment research endeavours and we empower them to become effective partners in the AI-driven healthcare ecosystem.

The introduction of AI into the MBBS UG curriculum is not merely a technological advancement; it is a necessity. The healthcare industry is increasingly adopting AI-powered tools and technologies, transforming the way diagnoses are made, treatment decisions are reached, and patient care is delivered. To effectively function in this new era of medicine, future physicians must possess a comprehensive understanding of AI and its role in healthcare. Through structured modules, practical training, and experimental learning, students delve into the multifaceted facets of AI applications in healthcare. This innovative educational paradigm spans various dimensions:

1. Understanding AI Fundamentals: Students embark on a comprehensive journey elucidating the fundamentals of AI, encompassing machine learning, neural networks, natural language processing, and computer vision. This foundational knowledge forms the bedrock for subsequent exploration in healthcare applications.

2. AI-Driven Diagnostics and Imaging: In-depth exploration of AI-driven diagnostic tools and imaging techniques acquaints students with the nuances of interpreting AI-generated analyses, facilitating accurate and swift diagnosis across diverse medical specialties. It also incorporates case studies, simulations, and hands-on experiences to demonstrate the practical applications of AI in medical specialities

3. Personalized Medicine and Predictive Analytics: The curriculum elucidates the role of AI in tailoring treatment modalities through personalized medicine, leveraging predictive analytics to prognosticate diseases, optimize treatment plans, and prescribe tailored interventions.

4. Streamlined Administrative Tasks: Insights into AI-driven modalities to automate repetitive administrative tasks, such as scheduling appointments, processing insurance claims, and managing patient records, freeing up physicians' time to focus on direct patient care.

5. Ethical and Regulatory Frameworks: Emphasizing the ethical, legal, and societal implications of AI in healthcare ensures students are cognizant of responsible AI deployment, patient confidentiality, and the ethical considerations inherent in integrating AI into medical practice.

6. Collaborative Research and Innovation: Encouraging collaborative projects and research initiatives, the curriculum fosters an environment conducive to innovation, empowering students to ideate, develop, and implement AI-powered solutions to address contemporary healthcare challenges.

The augmentation of the MBBS undergraduate curriculum with AI heralds a transformative paradigm, empowering future healthcare professionals with a profound understanding of cutting-edge technologies. By equipping students with the prowess to harness AI for enhanced patient care, precision medicine, and innovative healthcare solutions, this evolutionary integration epitomizes a commitment to shaping a future where medicine and technology harmoniously converge for the betterment of global healthcare.

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Acknowledgments

As we reflect on the journey of writing ***"Harnessing AI in Healthcare Education and Research: A Multifaceted Approach,"*** our heart swells with gratitude for those who have made this endeavour not just possible, but a truly enriching experience.

At the forefront of these invaluable contributions is Executive Director ***Prof. Dr. Col. CDS Katoch***, whose unwavering support and guidance have been the lighthouse in the vast ocean of this project. Prof. Katoch sir, your profound expertise and visionary leadership in the realm of AI and healthcare have been instrumental in shaping the narrative of this book. Your initiative for innovation and excellence has been a constant source of inspiration and motivation. Your keen insights have immensely enriched the content and direction of this work. It is an honour and privilege for us to have the opportunity to work under your esteemed guidance.

We also extend our heartfelt thanks to all Deans, Deputy Director (Admin) Colonel Puneet Kumar Arora, Administrative officer, and whole administrative department, whose seamless support and diligent efforts have been pivotal in the smooth progression of this project. The dedication and efficiency in managing the logistics and providing necessary resources have allowed us to focus on the essence of the book. The supportive and collaborative environment has foster is a testament to the professionalism and commitment of the team.

This book is not just a compilation of research and ideas, but a tapestry woven with the dedication, expertise, and support of remarkable efforts by all HoDs & In-charges of various Departments. We are profoundly grateful for your invaluable contributions and honoured to have embarked on this journey with you.

Authors

Index

Empowering Healthcare Education & Research through Artificial Intelligence: A Comprehensive Strategy- The AIIMS Rajkot Initiative

Organized by:

AIIMS Rajkot, Gujarat

Event Details:

Date: 19th November 2023
Location: Lecture Hall -1, AIIMS Rajkot

Summary of Workshop:

This workshop was a pioneering initiative to embed AI within the realms of healthcare, particularly accentuating its pedagogical and research applications. Designed for the educators of AIIMS Rajkot, the program's goal was to bolster their acumen in AI and facilitate the integration of AI-centric modules into their academic syllabi.

Aims:

1. Pedagogical Advancement: Empower educators with essential AI knowledge and skills tailored for healthcare education.
2. Research Amplification: Provide a deep dive into the role of AI in healthcare research advancement.
3. Experiential Learning: Offer immersive experiences with state-of-the-art AI tools and technology.
4. Data Management Expertise: Offer insights into proficient data management and ethical AI use.

Attendance:

The event saw the participation of 42 distinguished faculty members spanning various departments at AIIMS Rajkot.

Preliminary Arrangements:

Prior to the event, attendees were supplied with extensive resources via email, including session outlines, AI-related healthcare literature, and assignments to solidify their grasp of the discussed topics. This proactive educational strategy aimed to optimize the workshop's efficacy.

Comprehensive Report on the Workshop:

The workshop commenced with an inaugural address by the esteemed Executive Director, Prof. Dr. (Col) CDS Katoch, who underscored AI's pivotal role in modern healthcare. He highlighted AI's potential to significantly improve patient treatment and research paradigms.

Prof. (Dr.) Sanjay Gupta spearheaded the inaugural session with an exhaustive overview of AI's intersection with healthcare education and research. His discourse covered AI's foundational elements and its indispensable incorporation into the healthcare curriculum.

Following this, Dr. Pradip Chauhan and Dr. Lalit Ratanpara led an interactive segment featuring hands-on engagement with accessible AI software, illustrating the practical utility of these tools in healthcare.

In a case-study format, Dr. Abhishek Padhi and Dr. Vinay Chitturi delved into a Sepsis Prediction Model, elucidating the lifecycle of an AI algorithm from conception to execution, showcasing its predictive prowess in healthcare.

Emphasizing real-world applications, Dr. Bhautik Modi addressed the criticality of ethical considerations and standards in patient data management.

Concluding the sessions, Dean Academics Prof. Dr. Sanjay Gupta encapsulated the day's discussions, stressing the necessity of assimilating AI in healthcare education and research. The event culminated in a valedictory session that encouraged participants to apply their newfound knowledge.

Review and Assessment:

Post-workshop, attendees completed a feedback form via Google Sheets, enabling the organizers to capture candid reflections on the sessions' quality and applicability. Twenty-one participants provided high ratings, reflecting overall contentment with the workshop.

Long-term Outlook:

The workshop's influence is expected to ripple through the future of AI in healthcare, enhancing the creation of innovative AI solutions in clinical, research, and educational domains. The workshop also aimed to cultivate a collaborative network among healthcare professionals skilled in AI. This network is crucial in an era marked by AI's expanding role in healthcare, demanding a workforce adept at embracing technological progress.

Conclusion:

This workshop served as a crucible for the exchange of knowledge and skills development in AI for healthcare practitioners. Balancing theoretical understanding with hands-on application, it provided a rich tapestry of AI's significance in healthcare education and research. The insights garnered will be instrumental in refining future workshops, ensuring they continue to resonate with the dynamic needs of healthcare professionals. This initiative signifies a bold leap towards the integration of AI in healthcare's future.


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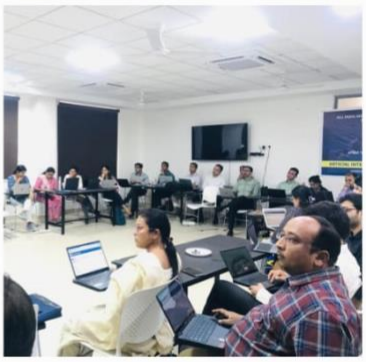

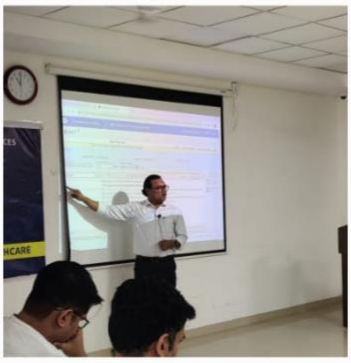


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Chapter 1. The History and Fundamentals of AI

Introduction

This module explores the journey of Artificial Intelligence (AI) from its earliest conceptualization to its current state as a transformative technology in various sectors. Participants will gain an understanding of AI's foundational theories, its evolutionary path, and the core concepts that underpin its current applications.

The Dawn of AI

The story of AI begins long before the advent of computers, rooted in the ancient world where philosophers like Aristotle and mathematicians such as Al-Khwarizmi laid down the foundational thoughts of logical reasoning and algorithms, respectively. The formal inception of AI as a recognized field was marked by Alan Turing's seminal paper "Computing Machinery and Intelligence" (1) in 1950, proposing the Turing Test as a criterion of Intelligence for machines. This led to the Dartmouth Conference in 1956 (2), a gathering that coined the term 'Artificial Intelligence' and set the research agenda for decades to come.

The Evolution of AI

- ***Early AI***

The 1950s and 1960s witnessed significant investment and achievements in AI. Early programs like the Logic Theorist and ELIZA demonstrated the potential of machines to perform tasks previously thought to require human Intelligence, such as problem-solving and language processing.

- ***AI Winter***

The 1970s and 1980s saw the first of the 'AI Winters,' a term describing the periods of reduced funding and interest in AI. Expectations had overshot the reality of AI's capabilities, leading to disappointment and scepticism.

- ***AI Renaissance***

The resurgence of AI in the late 1990s and early 2000s was fuelled by the rise of the internet, exponential increases in computational power, and the availability of vast amounts of data. This era saw the development of algorithms that could defeat humans in complex games like Chess and Go, signifying AI's advanced capabilities.

Definitions

- ***Artificial Intelligence (AI)***

AI is defined as the simulation of human Intelligence processes by machines, especially computer systems. These processes include learning, reasoning, and self-correction.

- ***Machine Learning (ML)***

ML, a subset of AI, involves the development of algorithms that allow computers to learn from and make predictions or decisions based on data.

- ***Deep Learning (DL)***

DL is a subset of ML inspired by the structure of the human brain, utilizing artificial neural networks to interpret complex data structures (4).

Core Concepts

- ***Neural Networks***

Neural networks, at the heart of DL, are a series of algorithms modelled loosely after the human brain, designed to recognize patterns. They interpret sensory data through a kind of machine perception, labelling, or clustering raw input.

- ***Types of Learning***

Learning paradigms within ML include supervised learning, where the model learns from labelled data; unsupervised learning, which finds hidden patterns or intrinsic structures in input data; reinforcement learning, where an agent learns to make decisions by performing actions and receiving feedback; and semi-supervised learning that combines a small amount of labelled data with a large amount of unlabelled data during training (5).

- ***Real-world Analogies***

To better grasp the concept of neural networks, one can compare it to the process of human learning. As humans learn from experiences, adjusting their understanding and behaviour, neural networks adjust their weights (parameters) based on data inputs to improve their performance.

Closing

The current state of AI is one of rapid advancement and integration into various domains. With ongoing research pushing the boundaries of what AI can achieve, the potential for future applications appears limitless. This sets the stage for a deeper dive into how AI is being applied across different fields, which will be explored in subsequent modules.

Chapter 2. AI Literacy and Education: Empowering Stakeholders

Introduction to AI Literacy

This module underscores the crucial role of AI literacy for stakeholders in diverse fields. With AI's integration into healthcare, education, research, and administrative operations, a foundational understanding of AI technologies is essential. Our objective is to empower stakeholders, including healthcare providers, educators, researchers, and administrative staff, with the requisite knowledge and skills to comprehend, utilize, and critically evaluate AI technologies in their respective domains.

Fundamentals of AI Literacy

- ***Understanding AI Technology***

Participants will gain a foundational understanding of AI, including the core principles of machine learning, neural networks, and data analysis. This knowledge base is essential for stakeholders to recognize how AI applications can enhance and streamline their professional tasks [1].

- ***AI Terminology***

A solid grasp of AI terminology is vital for effective communication and conceptual understanding within the AI sphere. Key terms include:

- ***Algorithm***

A set of rules or instructions given to an AI system to help it learn from data [2].

- ***Training Data***

The dataset from which the AI system learns and develops its understanding. The quality and size of this data can significantly influence the performance of the AI model [2].

- ***Model***

The representation of what an AI system has learned from the training data. It applies the learned patterns to new data to make predictions or decisions [2].

- ***Inference:***

The process by which an AI model applies what it has learned to new, unseen data to make predictions or decisions [2].

AI in Decision-Making

➢ *AI-Assisted Decisions*

The use of AI to enhance decision-making underscores the significant role AI plays in various professional contexts. However, it's equally important to maintain human oversight to navigate the ethical and practical outcomes AI presents [3].

➢ *Critical Assessment of AI*

Stakeholders will learn the importance of critically assessing AI tools and technologies. This includes evaluating the tools' reliability, the validity of their outputs, and their utility for specific tasks [4].

Ethical and Social Implications of AI

➢ *Ethical Considerations*

An exploration of AI's ethical landscape delves into the principles of fairness, accountability, and transparency. Participants will understand the importance of ethical considerations in developing and deploying AI systems [5].

➢ *Social Impact*

AI's potential societal impacts, particularly in terms of employment, privacy, and social equity, will be examined. Discussions will emphasize the importance of deploying AI in a manner that is equitable and beneficial for all sectors of society [6].

Educating the Next Generation

➢ *Integrating AI into Curricula*

The module discusses strategies for weaving AI education into existing curricula, ensuring that future professionals are versed in AI literacy across various disciplines [7].

➢ *Preparing Students for an AI Future*

The curriculum emphasizes the need to prepare students with skills such as adaptability, problem-solving, and ethical reasoning, to navigate a future in which AI is ubiquitous [8].

Developing Institutional AI Strategies

- ***Creating an AI Vision***

  Guidance is provided on how to develop a strategic vision for AI that aligns with an institution's broader goals. This ensures that AI initiatives support and enhance institutional objectives [9].

- ***Investment in AI Education***

  The discussion revolves around the need for significant investment in AI education. This encompasses not only financial investment but also dedicating resources to training programs and learning materials essential for building AI literacy [10].

Conclusion

The conclusion of this module reiterates that AI literacy is multifaceted, encompassing both technological understanding and an awareness of its broader societal and ethical implications. Stakeholders are encouraged to continue their AI education actively and to engage in shaping the dialogue around AI's role within their professional communities.

Introduction to AI in Healthcare

AI is revolutionizing healthcare by enhancing patient care, accelerating medical research, and streamlining administrative processes. It leverages vast datasets from healthcare systems to aid in complex decision-making, often processing and analysing information more quickly and accurately than traditional methods [1].

AI in Medical Diagnosis

- ***Image Analysis***

AI's role in diagnostic imaging has become increasingly crucial. Machine learning algorithms, trained on thousands of images, can detect patterns indicative of diseases like cancer, pneumonia, or bone fractures [2]. These AI systems offer radiologists a valuable second opinion and have been shown to reduce the rate of missed diagnoses significantly [3].

- ***Predictive Analytics***

AI utilizes historical data, including EHRs, to forecast future healthcare events. It can predict disease outbreaks, hospital readmissions, and identify patients at risk of developing chronic conditions, thereby improving patient outcomes, and optimizing resource allocation [4].

AI in Treatment Personalization

- ***Precision Medicine***

AI is a key component in the move towards precision medicine, where it analyses complex data sets to suggest individualized treatment regimens. In oncology, AI assists in drug development and in tailoring cancer treatments to patients' genetic profiles [5].

AI in Hospital Management

- ***Operational Efficiency***

AI enhances hospital operational efficiency by optimizing scheduling, reducing wait times, and forecasting the need for medical supplies, thereby reducing overhead costs and enhancing patient satisfaction [6].

Ethical Considerations

- ***Privacy and Bias***

The potential for AI to introduce bias into healthcare decision-making is a concern that must be addressed by using diverse training data sets to ensure equitable AI decisions [7].

Furthermore, strict data privacy measures are necessary to protect patient information, adhering to regulations like HIPAA [8].

Conclusion and Future Directions

The module concludes with a look into the future, where AI might enable continuous health monitoring through wearable technology, contributing to a shift towards proactive healthcare [9]. It is emphasized that while AI is transforming healthcare, it is intended to complement—not replace—the critical role of human healthcare providers.

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Introduction to AI in Medical Education

The integration of Artificial Intelligence (AI) in medical education heralds a transformative era, promising to reshape the landscape of medical training and practice. AI stands poised to tailor educational experiences, automate administrative tasks, and significantly enhance clinical training, creating a dynamic learning environment for medical students and professionals [1].

Personalized Learning

- ***Adaptive Learning Platforms***

AI-powered adaptive learning platforms revolutionize medical education by personalizing the learning experience. These platforms analyse individual student performance and learning patterns, adjusting the delivery of educational content to suit each learner's unique needs, thereby optimizing the educational experience [2].

- ***Virtual Patients and Simulations***

AI facilitates the creation of sophisticated virtual patient simulations, providing medical students with a safe and controlled environment to practice their clinical skills. These simulations offer realistic patient interactions, complete with a wide array of symptoms and medical histories, allowing for nuanced feedback and assessment of student performance [3].

Curriculum Development and Assessment

- ***Automated Curriculum Design***

AI's analytical capabilities extend to curriculum development, where it can process educational data to inform and shape curricula, ensuring they align more closely with student needs and the ever-evolving landscape of medical knowledge and practice [4].

- ***Automated Assessment***

AI also plays a pivotal role in assessment, where it can grade objective tests and provide personalized feedback, thus freeing educators to concentrate on more complex, subjective teaching tasks and facilitating more in-depth student-teacher interactions [5].

Enhancing Clinical Training

- ***AI in Clinical Decision Support***

AI tools serve as valuable assets in clinical decision support, aiding in the diagnosis and treatment of patients. When integrated into medical education, these tools provide students with real-world problem-solving experiences, bridging the gap between theory and practice [6].

- ***Augmented Reality (AR) and Virtual Reality (VR)***

AR and VR technologies are increasingly integrated into medical training, offering immersive experiences that simulate real-life surgical procedures and patient interactions. This technology enhances the depth and breadth of clinical training, providing students with a realistic and engaging learning platform [7].

Research and Continuous Learning

- ***AI-assisted Research***

AI proves instrumental in research by sifting through large datasets and identifying relevant studies, trends, and data. It supports medical students and professionals in staying abreast of the latest research, fostering a culture of continuous learning and evidence-based practice [8].

Ethical and Practical Considerations

- ***Bias and Reliability***

The module emphasizes the importance of critically evaluating AI tools for potential biases to ensure educational equity and the significance of using high-quality data to train AI systems. Ensuring the reliability of AI inputs and outputs is crucial for maintaining the integrity of medical education [9].

- ***The Role of Educators***

While AI offers numerous benefits, the role of educators remains paramount. Experienced educators provide essential context, ethical perspectives, and interpersonal

skills training that AI cannot replicate, underscoring the complementary nature of AI in medical education [10].

Chapter 5: AI in Research

Introduction to AI in Research

Artificial Intelligence (AI) is rapidly transforming the research landscape across disciplines. By expediting discoveries and refining the research process, AI is not just a tool but a formidable ally in the quest for knowledge. It adeptly manages complex data analysis, fosters the generation of new hypotheses, and takes over routine tasks, freeing researchers to delve deeper into strategic inquiry [1].

AI in Data Analysis

➢ ***Big Data in Research***

In an era where research generates vast quantities of data, AI has become indispensable in managing and interpreting this 'Big Data'. AI systems are equipped to handle the volume, velocity, and variety of data, making sense of it in ways that would be overwhelming for human researchers [2].

➢ ***Pattern Recognition***

AI excels at identifying patterns and correlations within large datasets, often revealing insights that may escape human observation. This capability is vital for uncovering subtle, complex patterns in data, from genomic sequences to environmental changes [3].

Predictive Modelling and Hypothesis Generation

➢ ***Predictive Analytics***

AI's prowess in predictive analytics is harnessed to forecast future research outcomes from historical data. Utilizing advanced statistical techniques, AI can anticipate trends and events with a degree of precision that is invaluable for proactive research planning [4].

➢ ***Hypothesis Generation***

AI also aids in hypothesis generation by sifting through existing data to propose novel research questions. This process can unveil pioneering research questions, steering scientific inquiry into uncharted territories [5].

Research Automation

- ***Automation of Routine Tasks***

The automation capabilities of AI streamline the mundane aspects of research, such as data entry, literature searching, and preliminary data analysis. This automation allows researchers to concentrate on more complex, thought-intensive work [6].

- ***Robotics and Lab Automation***

In many modern laboratories, AI-driven robots and automated systems are commonplace, performing tasks ranging from sample preparation to conducting intricate experiments. This automation increases efficiency and reproducibility, while also allowing for more complex experimental designs [7].

AI in Literature Review and Knowledge Synthesis

- ***Automated Literature Reviews***

AI significantly accelerates the literature review process, quickly summarizing research papers and synthesizing information across studies. This tool is particularly valuable in fields where literature is voluminous and rapidly expanding [8].

Ethical and Reliability Aspects

- ***Bias and Ethical Use***

The potential for AI to introduce bias is a pressing concern. Ensuring the ethical use of AI in research involves critical oversight and the implementation of measures to maintain the integrity and objectivity of research findings [9].

- ***Reproducibility***

The reproducibility of AI in research findings is a foundational pillar of scientific inquiry. Transparent AI methodologies are essential to validate the results and foster trust in AI-generated research [10].

Chapter 6: Implementing AI in Practice: Challenges and Considerations

Introduction to Implementation

The implementation of Artificial Intelligence (AI) across healthcare, education, and research is a monumental task with significant potential to enhance efficiency and outcomes. However, the practicality of embedding AI within these sectors brings forth a spectrum of challenges and considerations. Success hinges not only on the technology itself but also on the strategic approach to its adoption [1].

Challenges in AI Implementation

- ***Data Quality and Quantity***

The adage 'garbage in, garbage out' is particularly pertinent in AI. High-quality, extensive datasets are the lifeblood of AI models, and yet, acquiring and curating such data poses considerable challenges. Ensuring data accuracy, diversity, and representativeness is crucial for the development of reliable AI systems [2].

- ***Integration with Existing Systems***

AI does not exist in a vacuum. Integrating it into existing infrastructures is often fraught with challenges, including compatibility issues with current technologies and the potential disruption of established workflows [3].

Ethical and Legal Considerations

- ***Privacy and Security***

Data privacy and security are paramount in AI implementation. Ethical and legal frameworks must be established to protect sensitive information, necessitating a robust approach to cybersecurity [4].

- ***Regulatory Compliance***

Navigating the regulatory landscape is critical. Compliance with standards like GDPR in Europe, HIPAA in the USA, ICMR in India and other local regulations must be ensured to foster trust and legal integrity in AI applications [5].

Building AI Competency

- ***Education and Training***

For AI to be effectively implemented, stakeholders need to be educated and trained. Understanding how to interact with and manage AI systems is essential for harnessing their potential and mitigating risks [6].

- ***Change Management***

The human aspect of AI implementation cannot be overstated. Addressing apprehensions, managing expectations, and securing buy-in are critical components of successful AI adoption. Change management strategies are vital in facilitating the transition to AI-augmented processes [7].

Evaluating AI Solutions

- ***Vendor Assessment***

Choosing the right AI vendor or solution requires careful consideration. Criteria such as performance metrics, support, and scalability must be evaluated to ensure the solution meets the organization's needs [8].

- ***Pilot Projects and Testing***

Pilot projects play a key role in the evaluation phase, allowing organizations to test AI solutions on a smaller scale. This step is critical for assessing the impact of AI and making necessary adjustments before wider implementation [9].

Futureproofing and Scalability

- ***Adaptability to Future Trends***

AI solutions must be flexible enough to adapt to ongoing developments in technology. As the fields of healthcare, education, and research evolve, so too must the AI systems that support them [10].

- ***Scaling AI Solutions***

Scaling AI solutions presents its own set of challenges, including maintaining performance levels and managing costs. Scalability must be a core consideration from the outset to ensure the longevity and sustainability of AI initiatives [11].

Chapter 7: Future Trends and Innovations in AI

Introduction to Future Trends

The domain of Artificial Intelligence (AI) is evolving at an unprecedented rate, with advancements emerging rapidly. Understanding these developments is not an academic exercise but a practical necessity. By staying informed of future trends, institutions and professionals can prepare and adapt, ensuring they harness the potential of AI advancements proactively [1].

AI and Emerging Technologies

- ***Quantum Computing***

Quantum computing represents a quantum leap for AI's processing power and data analysis capabilities. By leveraging the principles of quantum mechanics, AI applications can operate at speeds and efficiencies previously unattainable, potentially solving complex problems that are currently intractable [2].

- ***Edge AI***

The concept of Edge AI brings computation and data storage closer to the location where it is needed, at the edge of the network, near the source of the data. This shift has significant implications for real-time analytics, privacy, and the reduction of latency in AI applications [3].

AI in Genomics and Precision Medicine

- ***Genomics***

AI's role in genomics is becoming increasingly crucial as it aids in predicting disease risk and decoding complex genetic mutations. AI algorithms can analyse vast genomic datasets to uncover patterns that contribute to disease, paving the way for breakthroughs in genetic research [4].

➢ ***Advanced Precision Medicine***

AI's analytical prowess is propelling precision medicine forward by integrating genetic, environmental, and lifestyle factors to personalize healthcare. This comprehensive approach has the potential to tailor treatments to individual patient profiles with unprecedented precision [5].

AI and the Internet of Medical Things (IoMT)

➢ ***IoMT Devices***

AI-powered Internet of Medical Things (IoMT) devices are set to transform patient monitoring and treatment. By collecting and analyzing data in real-time, these devices can provide continuous health monitoring, early detection of potential health issues, and timely interventions [6].

AI in Augmented and Virtual Reality

➢ ***AR/VR in Education and Training***

Augmented Reality (AR) and Virtual Reality (VR) technologies are revolutionizing medical education and training. They offer immersive, interactive learning experiences, simulating complex surgical procedures and patient interactions with high fidelity [7].

➢ ***AR/VR in Patient Care***

The potential uses of AR/VR in patient care are expansive, from enhancing rehabilitation protocols to providing therapeutic interventions. These technologies can create controlled environments for patients to engage in therapeutic activities in ways that traditional methods cannot replicate [8].

AI Ethics and Governance

➢ ***Developing AI Governance***

As AI becomes more integrated into societal functions, the need for robust governance frameworks grows. These frameworks are necessary to ensure AI is developed and deployed responsibly and ethically [9].

- ***Addressing AI Bias***

Efforts to detect and mitigate bias in AI systems are critical. Ensuring fairness and equity in AI applications is an ongoing challenge that requires continuous attention and dedicated resources [10].

Preparing for an AI-Driven Future

- ***Skills for the Future***

The future of healthcare, education, and research will demand new skills to work effectively with AI. Data literacy, interdisciplinary collaboration, and a deep understanding of AI capabilities and limitations will be key [11].

- ***Institutional Readiness***

Institutions must strategically plan for an AI-driven future. This includes investing in technology, fostering a culture of innovation, and ensuring that the workforce is prepared for the integration of AI into their daily operations [12].

Chapter 8: Embracing the AI Revolution: Strategies for Adoption and Adaptation

Introduction to AI Adoption

As we stand on the brink of a new era where Artificial Intelligence (AI) is reshaping our world, understanding and embracing this technology becomes imperative. The transformative potential of AI across healthcare, education, and research has been thoroughly examined in prior modules. Now, we turn our focus to strategic adoption and adaptation. Institutions and individuals must craft thoughtful strategies to harness AI's full potential, moving from passive observers to active participants in the AI revolution [1].

Strategic Adoption of AI

- ***Creating an AI Roadmap***

Developing a strategic AI roadmap is a critical first step. This roadmap should be tailored to an institution's specific goals, resources, and capabilities, laying out a clear path for AI integration that aligns with the organization's overall strategy [2].

- ***Aligning AI with Institutional Goals***

AI initiatives must not be siloed projects but should integrate seamlessly with and support the broader objectives and mission of the institution. AI should not dictate direction but rather serve to propel the institution's goals forward [3].

Capacity Building for AI

- ***Developing In-House AI Expertise***

Building in-house AI expertise is essential. This involves not only recruiting new talent with specialized skills but also investing in the training and development of existing staff. A knowledgeable team can effectively leverage AI to achieve organizational objectives [4].

- ***Leveraging External AI Resources***

Organizations can also look beyond their walls to leverage external AI resources. Collaborations with tech companies, academic institutions, and contributions to and from open-source AI communities can provide access to a wealth of knowledge and tools [5].

Change Management in AI Integration

➢ *Managing the Human Factor*

Integrating AI requires careful change management, addressing the human factors involved. Organizations must navigate fears, misconceptions, and resistance to technology, ensuring widespread buy-in and adoption [6].

➢ *Fostering an AI Culture*

Creating a culture that embraces innovation, continuous learning, and adaptability is critical in the face of AI advancements. A culture conducive to AI will view technology as an enabler of human potential rather than a substitute for it [7].

Policies and Governance for AI

➢ *Developing AI Policies*

Clear policies governing AI use within an institution are essential. These policies should cover ethical considerations, data governance, and accountability to ensure responsible use of AI [8].

➢ *AI Governance Structures*

Effective AI governance requires the establishment of structures and roles dedicated to overseeing AI initiatives. These structures should ensure that AI aligns with institutional values and complies with regulatory requirements [9].

Preparing for Disruption

➢ *Anticipating Disruptive Impacts*

Institutions must be proactive in anticipating the disruptive impacts of AI. This includes understanding how AI may alter workflows, job roles, and even the fundamental structure of the institution [10].

- ***Adaptation Strategies***

Adaptation strategies must be in place to address the disruptions caused by AI. This can involve upskilling staff, rethinking service delivery models, and continuously evaluating the impact of AI on the institution [11].

Department wise modules

- Anaesthesiology
- Pathology
- Pharmacology
- Physiology
- Anatomy
- Forensic Medicine & Toxicology
- Radiodiagnosis & Radiation Oncology
- Psychiatry
- Ophthalmology
- Clinical Biochemistry & Molecular Biology
- Dentistry
- Otorhinolaryngology
- Pediatrics
- Obstetrics & Gynecology
- Microbiology
- Community & Family Medicine

Anaesthesiology

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/SH/P	Core (Y/N)	Suggested Teaching Learning method	Suggested Assessment method
1	Identification of need of Artificial Intelligence in Anaesthesiology	K	K	N	Lecture, Small group discussion	Written/ Viva voce
2	Describe the vocabulary used in AI with definitions of all terminologies used in AI Definitions –Machine learning, Neural network, Deep Learning etc.	K	K	N	Lecture, Small group discussion	Written/ Viva voce
3	Describe the role of AI in a) Perioperative patient care b) Tele Anaesthesia	K	K	N	Lecture, Small group discussion	Written/ Viva voce
4	Introduction to AI powered Clinical Decision Support System in Anaesthesia	K	K	N	Lecture, Small group discussion	Written/ Viva voce
5	Introduction to Pharmacological models and mechanical Robots	K	K	N	Lecture, Small group discussion	Written/ Viva voce

Pathology

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/SH/P	Core (Y/N)	Suggested Teaching Learning method	Suggested Assessment method
1	Understand the present status of AI in Pathology	K	K	N	Lecture, Small group discussion	MCQs/Short notes
2	Know the algorithm of image analysis used in pathology	K	K	N	Lecture, Small group discussion	MCQs/Short notes
3	Know the opportunities and applications of AI in pathology diagnostics, research, and education	K	K	N	Lecture, Small group discussion	MCQs/Short notes
4	Know the challenges of AI in pathology	K	K	N	Lecture, Small group discussion	MCQs/Short notes
5	Use of telepathology (images) to make gross Morphology, differential diagnoses, annotate microscopic images, learning the salient pathological features of diseases.	K, S	SH, P	N	DOAP Session	MCQs/OSPE

Pharmacology

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/SH/P	Core (Y/N)	Suggested Teaching Learning method	Suggested Assessment method
1	Need of AI	K	K	N	Lecture/ Small group discussion	Written /Viva Voice
2	Basics principals of AI	K	K	N	Lecture/ Small group discussion	Written /Viva Voice
3	Application of AI in Pharmacology - AI in predicting drug response. - AI in optimizing treatment outcome. - AI in personalized drug selection - AI in dose optimization	K	KH (Through video – demonstration)	N	Lecture/ Small group discussion/ Video demonstration	Written /Viva Voice
4	AI in pharmacovigilance - Prediction and detection of ADR - Generate individual case safety report. - Risk assessment Signal detection	K	KH (Through video – demonstration)	N	Lecture/ Small group discussion	Written /Viva Voice

Physiology

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/SH/P	Core (Y/N)	Suggested Teaching Learning method	Suggested Assessment method
1	Introduction to Data Science and Artificial Intelligence	K	K	N	Lecture	MCQs
2	Fundamentals of Machine Learning for Healthcare	K	K	N	Lecture	MCQs
3	Digital Resources and AI in Academics	K	KH	N	Small group discussion	MCQs
4	AI in Diagnostics and Healthcare	K	KH	N	Small group discussion	MCQs
5	Database Management Systems (DBMS)	K	KH (Through video – demonstration)	N	Practical	Team assignment
6	Algorithms and Tools in AI	K	KH (Through video – demonstration)	N	Practical	Team assignment

Anatomy

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/SH/P	Core (Y/N)	Suggested Teaching Learning method	Suggested Assessment method
1	Intro. to AI 1. Definition & History 2. Concept of MI & HI 3. The impact of AI	K	K	N	Lecture/ Small group discussion	Written/Viva voce
2	Machine learning basics 1. Types of ML 2. Examples of ML 3. Exploration of advanced AI techniques	K	K	N	Lecture/ Small group discussion	Written/Viva voce
3	Realities & 3D printing 1. VR/AR/MR/XR 2. 3D Bio-printing & its application	K	K	N	Lecture/ Small group discussion/Video demonstration	Written/Viva voce
4	Learning resources in Anatomy 1. Type of AI powered learning resources. 2. Benefits of use 3. How to use AI powered tools	K	KH	N	Lecture/ Small group discussion/Video demonstration	Written/Viva voce
5	Case studies of AI in anatomy education	K, S	KH, SH	N	DOAP Session	Team assignment
6	AI-Enhanced Anatomical Imaging	K	K	N	Lecture/ Small group discussion	Written/Viva voce
7	Applications of AI in Cytogenetics	K	K	N	Lecture/ Small group discussion	Written/Viva voce
8	Limitations, Challenges, & Ethical considerations	K	K	N	Lecture/ Small group discussion	Written/Viva voce

Forensic Medicine & Toxicology

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/SH/P	Core (Y/N)	Suggested Teaching Learning method	Suggested Assessment method
1	Application of AI in Forensic Medicine 1. Crime scene investigation 2. Person identification 3. Reconstruction in mechanical injuries	K	K	N	Lecture/ Small group discussion	Written/Viva voce
2	Application of AI in Forensic Science Laboratory 1. Analytical Toxicology 2. Fingerprint detection 3. Blood grouping & Matching 4. DNA profiling	K	K	N	Lecture/ Small group discussion	Written/Viva voce
3	VR/AR/MR in Forensics & Education	K	K	N	Lecture/ Small group discussion	Written/Viva voce
4	Case studies: AI in Forensic Medicine	K	KH		DOAP Session	Team assignment

Radio diagnosis & Radiation Oncology

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/SH/P	Core (Y/N)	Suggested Teaching Learning method	Suggested Assessment method
1	Application of AI in Radiodiagnosis 1. Computer-aided detection (CAD) 2. Image segmentation & classification 3. Radiomics 4. Development of new diagnostic tools	K	K	N	Lecture/ Small group discussion	Written/Viva voce
2	Application of AI in Radiation Oncology 1. Image analysis & tumour Segmentation 2. Treatment planning Optimization 3. Adaptive Radiation Therapy 4. AI-powered treatment delivery systems	K	K	N	Lecture/ Small group discussion	Written/Viva voce

Psychiatry

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/SH/P	Core (Y/N)	Suggested Teaching Learning method	Suggested Assessment method
1	Doctor-patient relationship 1. Rapport building 2. Confidentiality in interview Patient simulation module	K, C	K, SH, P	N	Lecture/ Small group discussion/Video demonstration	Written/Viva voce
2	History taking & examination. 1. Situation-based simulations of case scenarios Simulation based identification of behaviour, speech, emotions, and cognitive symptoms	K, S, C	KH, SH	N	Lecture/ Small group discussion	Written/Viva voce
3	Stress- Identification & management	K, C	KH	N	Lecture/ Small group discussion	Written/Viva voce
4	Diagnosing Psychiatric illnesses 1. Mental health screening 2. Diagnostic formulation The Brain simulator	K, S	KH, SH	N	DOAP session	Team assignment
5	Personal mental health & wellbeing 1. Digital wearable devices Personalized audio-visual aids	K	K	N	Lecture/ Small group discussion	Written/Viva voce

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/SH/P	Core (Y/N)	Suggested Teaching Learning method	Suggested Assessment method
1	Application of AI in Ophthalmology Sensitization on use of AI in diagnosis and management of diabetic retinopathy, age-related macular degeneration, glaucoma, cataract, and corneal diseases	K	KH (Through video – demonstration)	N	Lecture/ Small group discussion	Written /Viva Voice
2	Demonstration of different AI software currently being used in Ophthalmology.	K	KH (Through video – demonstration)	N	Lecture/ Small group discussion	Written /Viva Voice

Ophthalmology

- **Module 1**

Name of the topic/Title	• Application of Artificial Intelligence (AI) in Ophthalmology
Objectives	• At the end of the module, the student should be able to understand the various application of AI in Ophthalmology
Detailed Description	• A lecture would be taken on how AI could be integrated in Ophthalmology. • Lecture would be followed by video demonstration which shows how AI is helpful in diagnosis and management of diabetic retinopathy, age-related macular degeneration, glaucoma, cataract, and corneal disease

Teaching/ Learning Method	• Lecture/ Small group discussion/ Video demonstration
Distribution of the session	• Introduction of the objective of the session • Lecture on role of AI in Pharmacology • Video demonstration • Q&A session
Formative Assessment	• Written short notes/ Viva Voice

➢ Module 2

Name of the topic/Title	Demonstration of different AI software currently being used in Ophthalmology.
Objectives	• At the end of the module, the student should be able to understand the use of available AI Software
Detailed Description	• A lecture will be taken on how AI could be helpful in Demonstration of different AI software currently being used in Ophthalmology. • The lecture will be followed by a video demonstration which shows how AI is helpful
Teaching/ Learning Method	• Lecture/ Small group discussion/ Video demonstration
Distribution of the session	• Introduction of the objective of the session • Lecture on role of AI in Pharmacovigilance • Video demonstration • Q&A session
Formative Assessment	• Written short notes/ Viva Voice

Clinical Biochemistry & Molecular Biology

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/SH/P	Core (Y/N)	Suggested Teaching Learning method	Suggested Assessment method
1	Diagnostic / Prognostic Utility Clinical Diagnosis and Management of various metabolic/endocrine diseases or disorders viz Myocardial Infarction, Diabetes with associated complications, Coronary Heart Disease, Alzheimer's disease, cancer and others.	K	KH	N	Lecture/ Small group discussion	Written /Viva Voice
2	Utility in Clinical Biochemistry Service Laboratory during the Pre-analytical, Analytical and Post-analytical phase.	K	KH	N	Lecture/ Small group discussion	Written /Viva Voice
3	Application of Artificial Intelligence in Molecular Biology Prediction of long non-coding RNAs based on deep learning. Protein secondary structure prediction Role in genetic diseases	K	KH	N	Lecture/ Small group discussion	Written /Viva Voice

Dentistry

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/SH/P	Core (Y/N)	Suggested Teaching Learning method	Suggested Assessment method
1	Incorporation of Artificial Intelligence (AI) in Diagnosis and treatment planning of common oral health problems in Dentistry.	K	KH (Through video – demonstration)	N	Lecture/ Small group discussion	Written /Viva Voice

1. Name of topics / title:	Incorporation of Artificial Intelligence (AI) in Diagnosis and treatment planning of common oral health problems in Dentistry.
2. Objectives	At the end of the module, the learner shall be able. 1. To understand and comprehend common oral health problems. 2. To understand basic AI tools used in dentistry for identifying dental diseases which affect the head and neck region. 3. To identify and detect common diseases of dental origin at initial stage through a VR model to advise and refer for timely management.
3. Detailed description	• To impart dental education through virtual patient simulators with the use of AI. • Student should achieve the skill to analyze dental patient records either electronic or experimental records and create a virtual identity mode. This model will help them to diagnose and differentiate disease with similar images, photographs and radiographs are entered.

	• Virtual dental assistance during emergency through tele-assistance. • Knowing different causes of pain of dental origin can help to prevent unnecessary referrals and help in proper investigations needed for that. • Basic knowledge of reading dental Xray (RVG, CBCT) which are itself AI based software analysis. • Also using virtual reality models can advise for medication for common oral health problems. • Based on orthopantomograms or CBCT (3D) scans, mandible morphology, can help to identify gender of patients and chronological age which can help in forensic medicine and for medicolegal cases. • For early diagnosis and treatment of oral precancerous and cancerous lesions through virtual reality model. • Imparting knowledge regarding oral health and its effects on systemic health and vice versa through AI models can help in prevention of early morbidity and mortality. • Algorithm should be able to identify and classify Dental traumatic injuries and understand major Maxillofacial traumatic injuries which require early management.
4. Teaching learning methods, media and modes	• Demonstration of parts of tooth, structures of oral cavity, importance of primary and permanent teeth, Explaining Dental caries through AI models of Caries detection, Dental Trauma, Gingival and periodontal diseases, and its primary management, Development of occlusion and classifying malocclusion, etc. • General Guidelines based VR models can help in better understanding of oral health problems like caries, malocclusion, periodontal diseases, dental trauma, fluorosis, etc at community level. • Knowing the process of identification through software and how to imply it under the software. • Software feed can help to identify specific disease- its etiology, prevalence, suggested investigations, differential diagnosis through comprehensive details and demonstration through photographs and radiographs. • Diagnose to study pattern and give predictions about stages of oral cancer through analysis of photographs.

5. Distribution of the session	**Introduction of the objectives of the learning session (5 minutes)** **Demonstration: (2 hours)** • Use of AI in dentistry. (15minutes) • VR model for Dental X-rays analysis, cysts and tumors, Dental caries, periodontal diseases, Dental Trauma. (15minutes) • Hands On experience. (30 minutes) • Group based activity to identify common oral health problems, their etiology, primary investigations, treatment options and prevention. (30 minutes) • Presentation by groups and Discussion. (30 minutes)
6. Formative assessment strategy	**Formative assessments.** (Demonstration of skill: Assessing Students skill through short quiz, group discussion, hands-on to acknowledge their understanding of oral health problems)

Artificial Intelligence in Otorhinolaryngology

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/SH/P	Core (Y/N)	Suggested Teaching Learning method	Suggested Assessment method
1	Application of **AI in Otology, Rhinology and Laryngology** Image Analysis Clinical Decision Support System AI in Surgery: Intraoperative Assistance and Simulation Training AI for Hearing Assessment AI for Hearing Devices and Implants Predictive models for ear disorders, such as predicting the outcomes of middle ear surgeries or hearing aid success.	K	KH (Through video – demonstration)	N	Lecture/ Small group discussion	Written /Viva Voice
2	**AI in Voice Disorders** AI for Voice Analysis and Diagnosis AI for Voice Synthesis and Modification AI for Voice Therapy and Training	K	KH (Through video – demonstration)	N	Lecture/ Small group discussion	Written /Viva Voice

Paediatrics

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/SH/P	Core (Y/N)	Suggested Teaching Learning method	Suggested Assessment method
1	AI based Simulation models for teaching Paediatric resuscitation techniques –	K/S	KH/SH	Y	DOAP	Written/Viva Voice/
2	Machine learning and obesity: Discussion	K	K	Y	Small group Discussion, DOAP	Written/Viva Voice
3	AI based PICU and NICU interventions for reducing mortality: discussion of principles of various models developed till date	S	SH	Y	Lecture, Demonstration, Bedside teaching	Written/ Viva Voice/ Skill Assessment
4	AI Based models for behaviour analysis	K	K	N	Lecture	Written/ Viva Voice

Obstetrics & Gynecology

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/SH/ P	Core (Y/N)	Suggested Teaching Learning method	Suggested Assessment method
1	**Applied Anatomy in OBGY** AI could be incorporated to deliver augmented reality experience for better understanding of the complex anatomy of the pelvic region. • Inclusion of 3D videos during lecture • Remote relay of live surgeries during clinical posting (Hysterectomy, Caesarean Section) • Use of AI applications like **Kahoot** to create interactive quizzes on anatomy.	K/S	KH/SH	Y	DOAP	Written/Viva Voice/
2	**Ultrasound in obstetrics and Gynaecology** ➢ Explain basis of Basic fetal biometry formulas (e.g. Hadlock) for prediction of fetal weight. ➢ Use of ultrasonographic features of ovarian mass to predict malignancy (ADNEX Model, RMI, ROMA model) ➢ Demonstrate use of AI in mapping fetal heart substructures & evaluation of cardiac function (fetal echo) ➢ Use in neurosonogrpahy to detect hydrocephalus, ventriculomegaly, Blake's pouch cyst, Dandy Walker malformation and cerebellar vermis hypoplasia	S/K	SH/KH	Y	Small group Discussion, DOAP	Written/Viva Voice/Skill Assessment

	➢ Demonstrate use of AI in anomaly detection by performing scan on standard planes: Transventricular brain; transcerebellar brain; Nuchal translucency; abdominal circumference; femur length view; facial profile; lips and nose; right and left outflow tract; four chamber view; three vessel trachea view; kidneys; sagittal spine; coronal spine. ➢ Use of deep learning architectures for comprehensive 2D+ spatio-temporal description in fetal anomaly US video scans ➢ Use of Machine learning algorithm based on a pattern-recognition feed-forward neural network on the trans perineal images to predict fetal position ➢ Foetal Heart Screening System: for automatic identification of cardiac anomalies in ultrasound images. When disparities arise between the test results and the acquired knowledge, the system makes an assessment that an anomaly exists. AI Based automated Amniotic Fluid assessment					
3	**Antenatal & Puerperal period** ➢ Possible use of consumer grades wearable devices, including smart rings and smartwatches, could track semi continuous physiological measures such as body temperature, heart rate variability and normal heart rate count, and oxygen saturation and blood pressure; and to also track other	S	SH	Y	Lecture, Demonstration, Bedside teaching	Written/ Viva Voice/ Skill Assessment

	behaviour measures such as quality of sleep & sleep duration in puerperal period. Vitals tracking can be used for early detection of pre-eclampsia & gestational hypertension, etc. ➢ Use of ultrasound technology for pelvic floor rehabilitation training using AI algorithm in postpartum pelvic organ prolapse. ➢ Prediction of exclusive breastfeeding during the in-hospital postpartum stay by machine learning algorithm and explain the ML model's behaviour to support decision making					
4	**Medical Disorders in Pregnancy** ➢ Predictive models to determine the risk of PE in early trimesters for better accuracy in the prediction of PE ➢ Calculation of various predictive scoring systems in women with chronic liver diseases (MELDS Score) encountered incidentally during pregnancy. Also formulation and diagnostic aid in the clinical setup of Jaundice in the Antenatal mother (pregnancy induced hyperbilirubinemia).	K	KH/SH	Y	Lecture, Demonstration, Bedside teaching	Written/ Viva Voice/ Skill Assessment
5	**Antenatal Surveillance, Normal Labour & Delivery** ➢ For 3 dimensional representations and teaching in topics like Mechanism of labour and events in labour, malpresentations, malpositions. ➢ There is scope for application of partographic plotting and detection of dysfunction during labour in heavy load institutions.	K	KH/SH	Y	Lecture, Demonstration, Bedside teaching	Written/ Viva Voice/ Skill Assessment

	➢ CTG monitoring during parturation, Doppler fetal heart rate surviellance at domicillary management in high risk pregnancy may be an avenue for future research with the aid of AI application. ➢ Support informed decisions regarding the appropriateness of performing a caesarean section during the process of Childbirth & helping to analyse the potential necessity for tools during vaginal delivery. ➢ Facilitate classification of intrapartum foetal heart rate, the prediction of labour start type (spontaneous or induced), the evaluation of risk for intrauterine growth restriction, and the estimation of foetal weight. • Automation of delivery units: considerations such as ward activity, personnel availability, and the anticipated complexity of the case may be taken into account for scheduling the delivery of a patient with a heightened susceptibility to post-partum haemorrhage or a newborn in need of specialized neonatal care during the day shift ensures the presence of the necessary personnel.					
6	**National Maternal Health Programmes:** Audits of various health programme outcomes may utilise AI & relevant softwares	K	KH	N	Lecture	Written
7	**Microbiology in Obstetrics & Gynecology** ➢ Use of AI in prediction and combating antibiotic resistance, as well as for customizing treatment	K	KH	N	Lecture/Small Group Discussion	Written/Viva Voice

	approaches. In the context of urinary tract infections (UTIs), both supervised and unsupervised modalities of machine learning has the capacity to detect and predict patterns at an early stage. Machine learning may provide expedited and proactive prevention capabilities to facilitate guidance					
8	**Episiotomy & OASIS** ➢ Simulation models to demonstrate a) how & when to give episiotomy b) suturing of Episiotomy c)OASIS Grading & repair Use of REEDA score for assessment of Episiotomy Healing	K/S	KH/SH	Y	Small Group Discussion/DOAP	Viva Voice/Skill Test
9	**PRETERM LABOUR** ➢ Deep learning and machine learning technique for prediction of preterm labour ➢ Amniotic fluid multiomics analysis ➢ Implication of cardiotocograph for prediction of true labour pain	K	KH	Y	Small Group Discussion	Viva Voice
10	**PROM** • Machine learning of prognostic prediction for prelabour rupture of membranes and time of delivery Implication of cardiotocograph	K	KH	Y	Small Group Discussion	Written test/ Viva Voice
11	**IUGR** • To study of prediction models for IUGR using AI (RF-SVM: Random forest-support vector machine) • Implications of AI Technique i.e. NMR & MS based metabolomics analysis Machine learning and USG measures to predict IUGR	K	KH/SH	Y	Small Group Discussion	Written test/ Viva Voice

12	**IUFD** • Utilisation of prenatal medical images, such as monitoring fetal development at each stage of pregnancy • Detection of fetal diseases during antenatal period by using AI Techniques • Use of prediction model for fetal death • Use of prediction model for still birth	K	KH/SH	Y	Small Group Discussion	Written test/ Viva Voice
13	. **Rh Isoimmunisation** • Use of machine learning of USG Doppler in prediction of fetal anaemia as a complication of Rh Isoimmunisation • Use of machine learning of USG for intrauterine blood transfusion as a treatment modality if fetal anaemia • Calculation of feto-maternal haemorrhage and dose requirement of anti D as a prophylaxis for Rh Isoimmunisation.	K	KH	N	Lecture	Written test/ Viva Voice
14	**Antepartum Haemorrhage** • Use of fetal Cardiotocography for assessment of fetal well being • Use of machine learning and deep learning of USG for prediction of Placenta Accreta Spectrum • Prediction and Diagnosis of APH by machine learning of USG • Use of MR Imaging for diagnosis of Different Placenta Accreta Spectrum	K	KH	N	Lecture	Written test/ Viva Voice

15	**Obstetric Shock** • AI application in predicting general pregnancy risk • Early prediction of Sepsis and septic shock (CDR model) • Use of AI algorithm to improve accuracy of sepsis diagnosis (SOFA Score) • AI application in the management of Shock i.e. PLR, TTE, Sepsis Bundle • AI implication to diagnose etiology of sepsis & septic shock and formulation of treatment strategies	K	KH	N	Lecture	Written test/ Viva Voice
16	**Gynaec Oncology** • Colposcopic Artificial Intelligence Auxiliary Diagnostic System (CAIADS) to detect abnormalities based on digital colposcopy images to assist in improving diagnostic accuracy and biopsy efficiency. • In the field of gynecological surgery, the use of augmented reality may help in detection of vital structures, thus decreasing complications, reducing operative time, and helping surgeons in training to practice in a realistic setting. • Using three-dimensional (3D) printers can provide materials that mimic real tissues and also helps trainees to practice on a realistic model. • 3D imaging allows better depth perception than its two-dimensional (2D) counterpart, allowing the surgeon to create preoperative plans according to tissue depth and dimensions. • Use of AI for efficient and accurate stratification of patients for the more extensive surgery (lymph node dissection) with preoperative identification of	K	KH	N	Lecture/ Demonstration	Written test/ Viva Voice

	women who have lymph node involvement will improve survival in Endometrial Cancer while reducing the surgical risk and morbidity					
17	**Gynecology** • Understanding developmental Anatomy using 3D Classification of uterine structure on Transvaginal Ultrasound/MRI may help in avoiding inappropriate surgery. • Automated detection of uterine fibroids in ultrasound images and targeted therapy (MRfUS) • Virtual reality-AI used to identify patient factors, repetitive patterns and treatment algorithms to project outcomes. • Virtual Realty to assess deep infiltrating endometriosis (DIE)	K/S	KH/SH	Y	Lecture/ Demonstration / Bed side teaching	Written/ Viva Voice/ Skill Test

18	**Assisted Reproductive Technology** • Time-lapse microscopy for automatization of embryo culture techniques. • Use of time-lapse imaging for monitoring morphological appearance and morphokinetic events for selection of viable embryos. • AI can review a massive amount of images from each embryo. The growth patterns from these images can be related to whether each embryo developed into an ongoing pregnancy. • Standardisation in AI for embryo grading, semen analysis, embryo and oocyte cryopreservation, quality control, and quality assurance • DIY(Do-it-yourself) IVF cycles	K	KH	N	Lecture/Group Discussion	Written/ Viva Voice

Microbiology

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/SH/P	Core (Y/N)	Suggested Teaching Learning method	Suggested Assessment method
1	**General Microbiology & AI** **Objective:** To understand the basic principles of microbiology and ascertain how AI tools can be instrumental in the rapid identification and interpretation of microbial results.	K/S/A	KH/SH	Y	Lecture/DOAP	Written/Viva Voice/Short projects.
2	**Bacteriology & AI** **Objective:** To recognize the methods by which AI aids in the identification of bacterial strains and the prediction of antibiotic resistance.	K/s	KH	Y	Lectures/ Small group Discussion/ DOAP	Written/Viva Voice/ reflective session
3	**Mycology & AI** To understand the potential of AI in assisting the identification of fungal pathogens and in predicting antifungal susceptibilities.	S	SH	Y	Lecture, Demonstration,	Written/ Viva Voice/ Reflective session
4	**Parasitology & AI**	K/S	KH/SH	Y	Lecture, Demonstration,	Written/ Viva Voice/ Reflective session

	To understand how AI tools can enhance parasite identification and play a significant role in epidemiological studies.					
5	**Virology & AI** To comprehend the potential and impact of AI in the realm of viral diagnosis, the prediction of viral evolution, and the streamlining of vaccine development	K/S	KH/SH	Y	Lecture, Demonstration,	Written/ Viva Voice/ Reflective session
6	**Immunology & AI** To gain insight into how AI can be pivotal in predicting immune responses, understanding vaccine reactions, and tailoring personalized immunotherapy.	K/S	KH/SH	Y	Lecture, Demonstration,	Written/ Viva Voice/ Reflective session
7	**Hospital Infection Control & AI** **Objective:** To understand the utilization and potential of AI in predicting, managing, and mitigating hospital-acquired infections (HAIs).	K/S	KH/SH	Y	Lecture, Demonstration,	Written/ Viva Voice/ Reflective session

Community and Family Medicine

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/SH/P	Core (Y/N)	Suggested Teaching Learning method	Suggested Assessment method
1	**Artificial Intelligence in preventive healthcare:**	K/S/A	K/KH/SH	Y	Lecture/DOAP/ Small Group Discussion	Written/Viva Voice
2	**Artificial Intelligence and *Precision Public Health* (places, persons and times)** a. Right intervention b. Right population c. Right time	K	KH	N	Lectures/ Small group Discussion	Written/Viva Voice/ reflective session
3	**Artificial Intelligence and epidemics** a. Forecasting or prediction models of spread of disease b. Vaccination related and natural immunity development and influence on diseasetransmission c. Demographic factors influence on prediction models d. Reliability of data and analysis in prediction models	K/S/A	KH/SH	Y	Lecture, Demonstration/ DOAP	Written/ Viva Voice/ Reflective session

4	**Artificial Intelligence and uniquely human skills cultivation in realistic simulated environment** a. Learning from previous models b. Engagement with family members c. Engagement with community stakeholders d. Practice with simulated models and comparison with real environment/ field situations	K/S	KH/SH	Y	Lecture, Demonstration	Written/ Viva Voice/
5	**Managing Healthcare in remote areas/ rural areas** a. Involvement of underprivileged and vulnerable populations having unequitable access to newer technology and tools b. Identifying alternative measures to provide comprehensive healthcare	K/S	KH/SH	Y	Lecture, Demonstration,	Written/ Viva Voice/
6	Artificial Intelligence -existing and future use in community medicine and public health research-only introduction in didactic teaching with some practical and demonstration in urban and rural health care delivery system	K/S	KH/SH	Y	Lecture, Demonstration,	Written/ Viva Voice/ Reflective session

Abbreviations

***AI** - Artificial Intelligence*

***ML** - Machine Learning*

***DL** - Deep Learning*

***EHR** - Electronic Health Records*

***AR** - Augmented Reality*

***VR** - Virtual Reality*

***IoT** - Internet of Things*

***IoMT** - Internet of Medical Things*

***GDPR** - General Data Protection Regulation*

***HIPAA** - Health Insurance Portability and Accountability Act*

***NLP** - Natural Language Processing*

***RPA** - Robotic Process Automation*

***CNN** - Convolutional Neural Network*

***RNN** - Recurrent Neural Network*

***GPT** - Generative Pre-trained Transformer*

***AIaaS** - AI as a Service*

***API** - Application Programming Interface*

***GPU** - Graphics Processing Unit*

***TPU** - Tensor Processing Unit*

***SVM** - Support Vector Machine*

***ANN** - Artificial Neural Network*

***EDA** - Exploratory Data Analysis*

***BI** - Business Intelligence*

***IoE** - Internet of Everything*

***RFID** - Radio-Frequency Identification*

***UX/UI** - User Experience/User Interface*

***OCR** - Optical Character Recognition*

***SQL** - Structured Query Language*

***JSON** - JavaScript Object Notation*

***XML** - eXtensible Markup Language*

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