
بسم الله الرحمن الرحیم

Artificial Intelligence in PICU

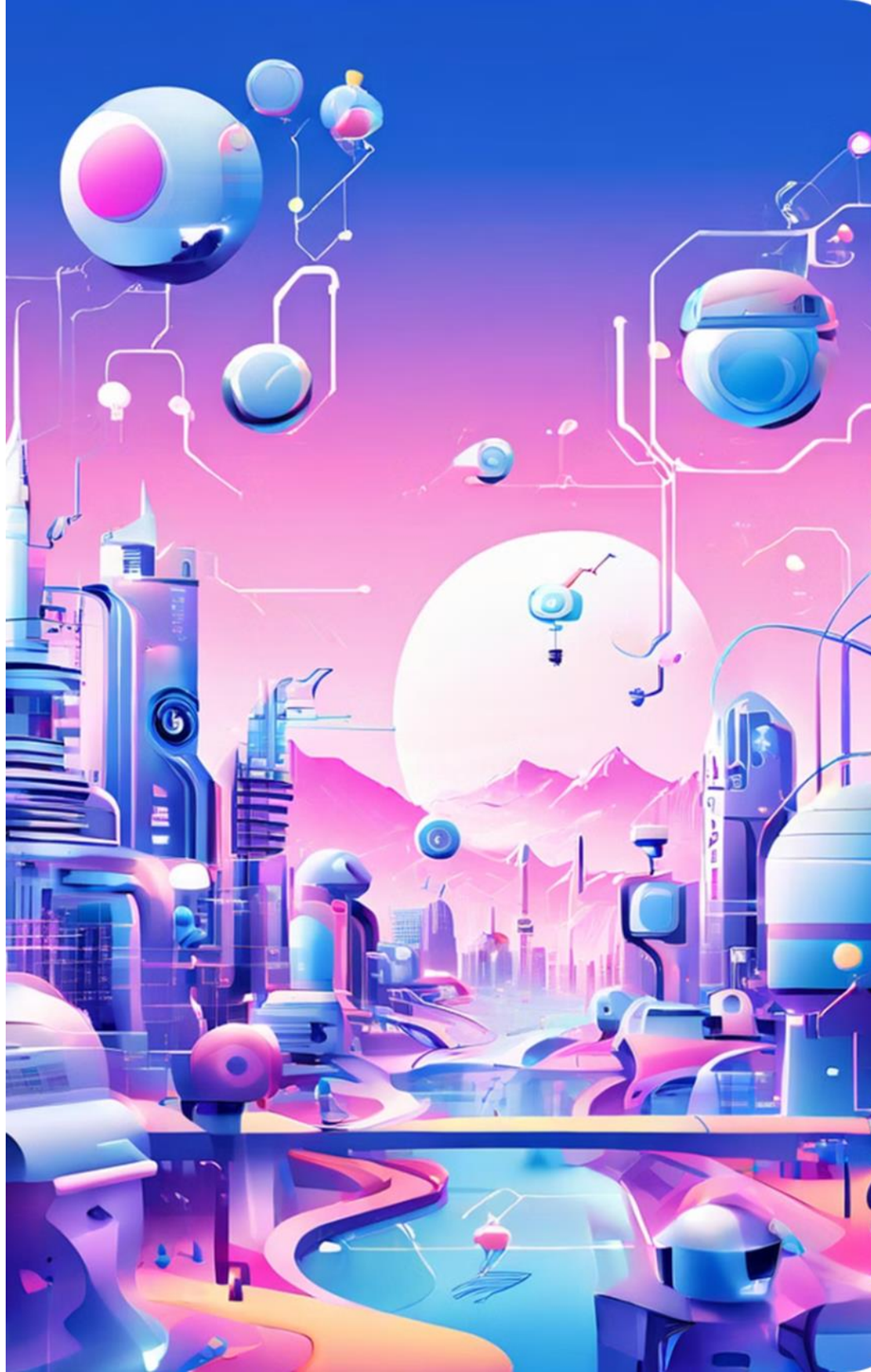
Farid Zand MD
Professor of Anesthesia and Critical Care Medicine
Department of Critical Care Medicine
Department of Artificial Intelligence
SUMS
Annual PICU Congress
Shiraz, 2024


سه تاسیس انجمن مرافقتهای ویژه ایران
شاخه فارس

Data

Data collection is ongoing and is being leveraged by software platforms to analyze patterns and make predictions across multiple industries

By 2025, it's estimated that the data volume to be created, copied, and consumed globally will hit a mind-blogging 463 exabytes



Artificial intelligence

Artificial intelligence - making machines smart - is a broad concept of advancing machines to match human intelligence, thinking, behavior, and reasoning

These machines are fed huge amounts of data to make them proficient in identifying patterns and interferences in a matter of seconds

The more data you have, the better you can fulfill organizational goals

Artificial Intelligence (AI) has immense

immense potential in **transforming**

healthcare

This presentation aims to address a better

better understanding of the role of **AI in**

AI in ICU and PICU

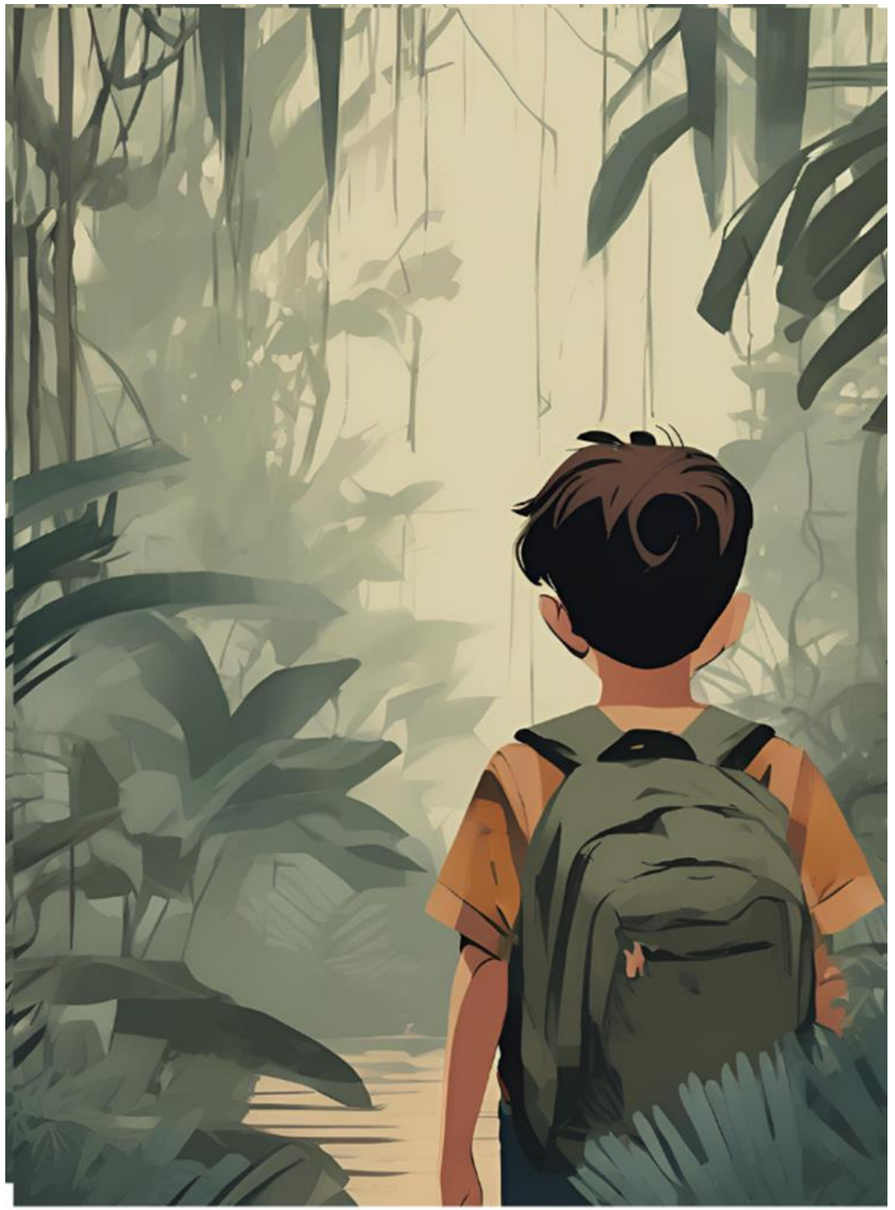
In the field of medicine, AI has shown promise to assist with a wide array of clinical tasks, including:

- **Risk prediction**
- **Diagnosis**
- **Augmented decision-making**
- **Treatment**
- **Monitoring**

Intelligent technology may also be leveraged to streamline workflows and automate some routine but historically time-intensive tasks, such as clinical note-taking

Given the growing and inevitable integration of AI into health care systems, intensivists urgently require training and orientation to the uses, promises, and pitfalls of AI in medicine

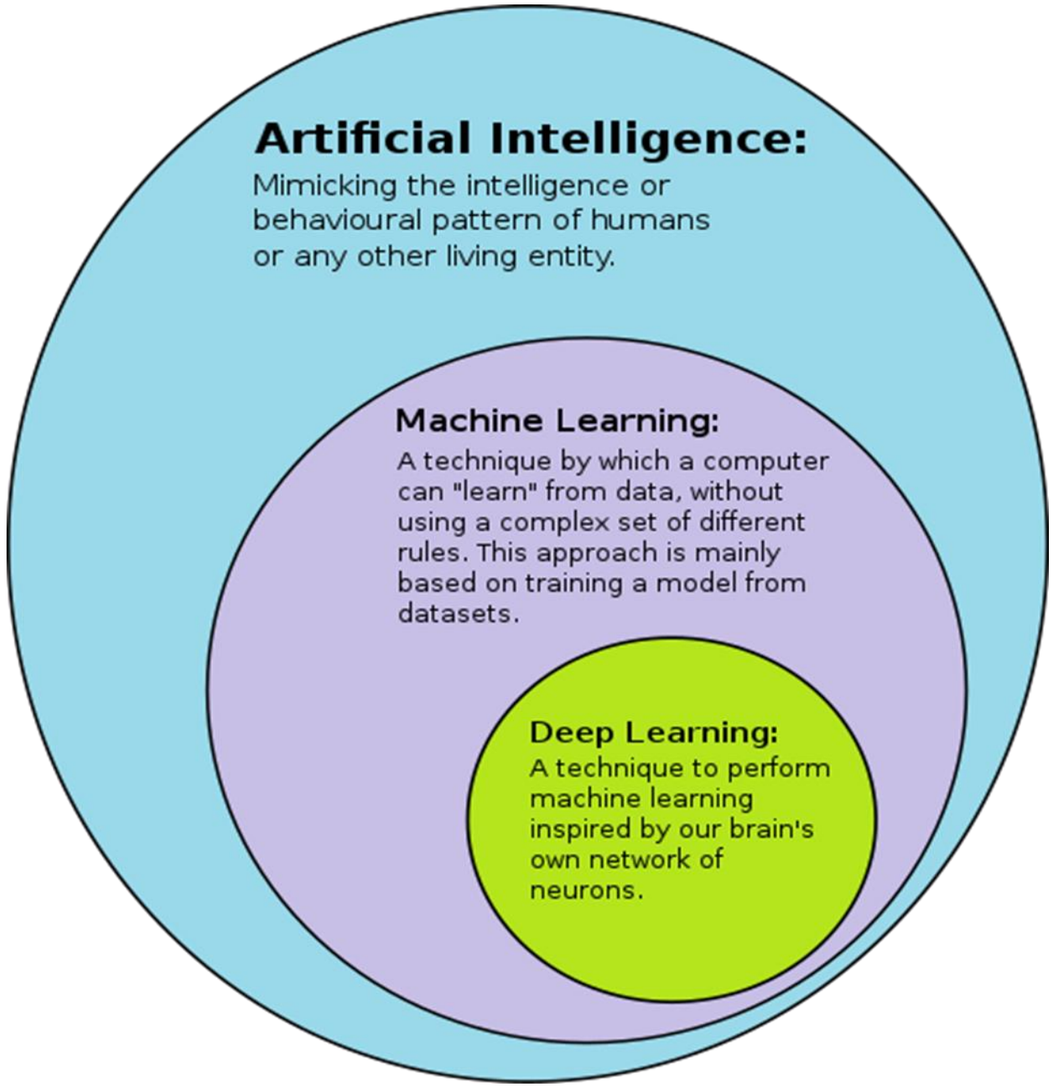
AI is unlikely to solve the full array of complex challenges confronting us today; however, if used responsibly, it holds great potential to improve many aspects of care for providers, children, and families



Although often used interchangeably in the critical care medicine literature, the terms AI and machine learning are not the same

AI has traditionally been used to describe a technology that mimics the intelligence of a human being

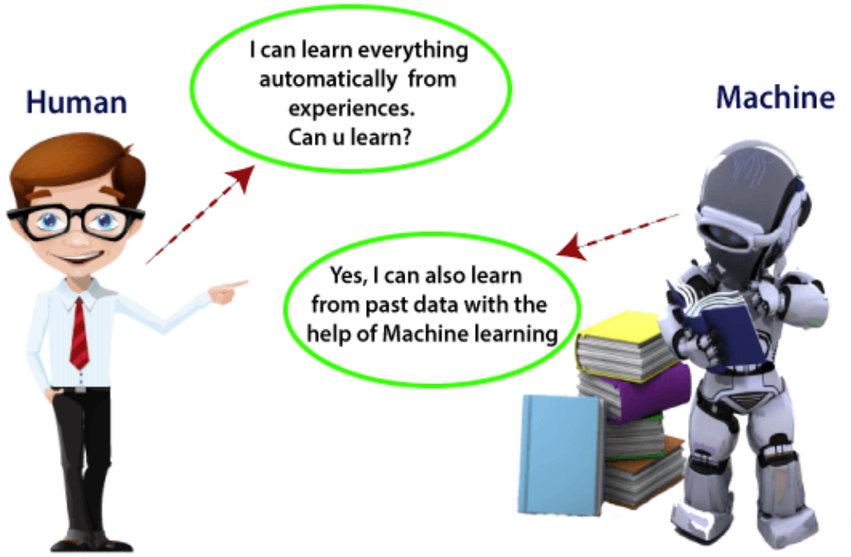
Machine learning is a subtype of AI that uses computer algorithms to analyse a dataset for patterns and relationships (creating a 'model')



Difference Between Artificial Intelligence and Machine Learning

AI focuses on creating intelligent machines that can perform tasks that typically require human intelligence, such as visual perception, speech recognition, decision-making, and natural language processing. It involves the development of algorithms and systems that can reason, learn, and make decisions based on input data

Machine learning:
A subclass of artificial intelligence



Machine learning includes a data-driven approach in which computers learn, adapt, grow, and develop by themselves with the data fed to them

They observe the dataset, recognize the patterns in it, learn from the behavior automatically, and make predictions

Frontiers in Pediatrics

PERSPECTIVE
published: 10 May 2022
doi: 10.3389/fped.2022.864755

Ignorance Isn't Bliss: We Must Close the Machine Learning Knowledge Gap in Pediatric Critical Care

Daniel Ehrmann[1,2*†], *Vinyas Harish*[2,3,4†], *Felipe Morgado*[2,3,5†], *Laura Rosella*[3,4], *Alistair Johnson*[3,6], *Briseida Mema*[1] and *Mjaye Mazwi*[1,3]

[1] *Department of Critical Care Medicine, Hospital for Sick Children, Toronto, ON, Canada,* [2] *Temerty Centre for Artificial Intelligence Research and Education in Medicine, University of Toronto, Toronto, ON, Canada,* [3] *MD/PhD Program, Temerty Faculty of Medicine, University of Toronto, Toronto, ON, Canada,* [4] *Institute for Health Policy, Management and Evaluation, Dalla Lana School of Public Health, University of Toronto, Toronto, ON, Canada,* [5] *Department of Medical Biophysics, Temerty Faculty of Medicine, University of Toronto, Toronto, ON, Canada,* [6] *Program in Child Health Evaluative Sciences, The Hospital for Sick Children, Toronto, ON, Canada*

Frontiers in Pediatrics

PERSPECTIVE
published: 10 May 2022
doi: 10.3389/fped.2022.864755

Pediatric intensivists are bombarded with more patient data than ever before. Integration and interpretation of data from patient monitors and the electronic health record (EHR) can be cognitively expensive in a manner that results in delayed or suboptimal medical decision making and patient harm. Machine learning (ML) can be used to facilitate insights from healthcare data and has been successfully applied to pediatric critical care data with that intent. However, many pediatric critical care medicine (PCCM) trainees and clinicians lack an understanding of foundational ML principles. This presents a major problem for the field. We outline the reasons why in this perspective and provide a roadmap for competency-based ML education for PCCM trainees and other stakeholders.

Intelligence Research and Education in Medicine, University of Toronto, Toronto, ON, Canada, [3] MD/PhD Program, Temerty Faculty of Medicine, University of Toronto, Toronto, ON, Canada, [4] Institute for Health Policy, Management and Evaluation, Dalla Lana School of Public Health, University of Toronto, Toronto, ON, Canada, [5] Department of Medical Biophysics, Temerty Faculty of Medicine, University of Toronto, Toronto, ON, Canada, [6] Program in Child Health Evaluative Sciences, The Hospital for Sick Children, Toronto, ON, Canada

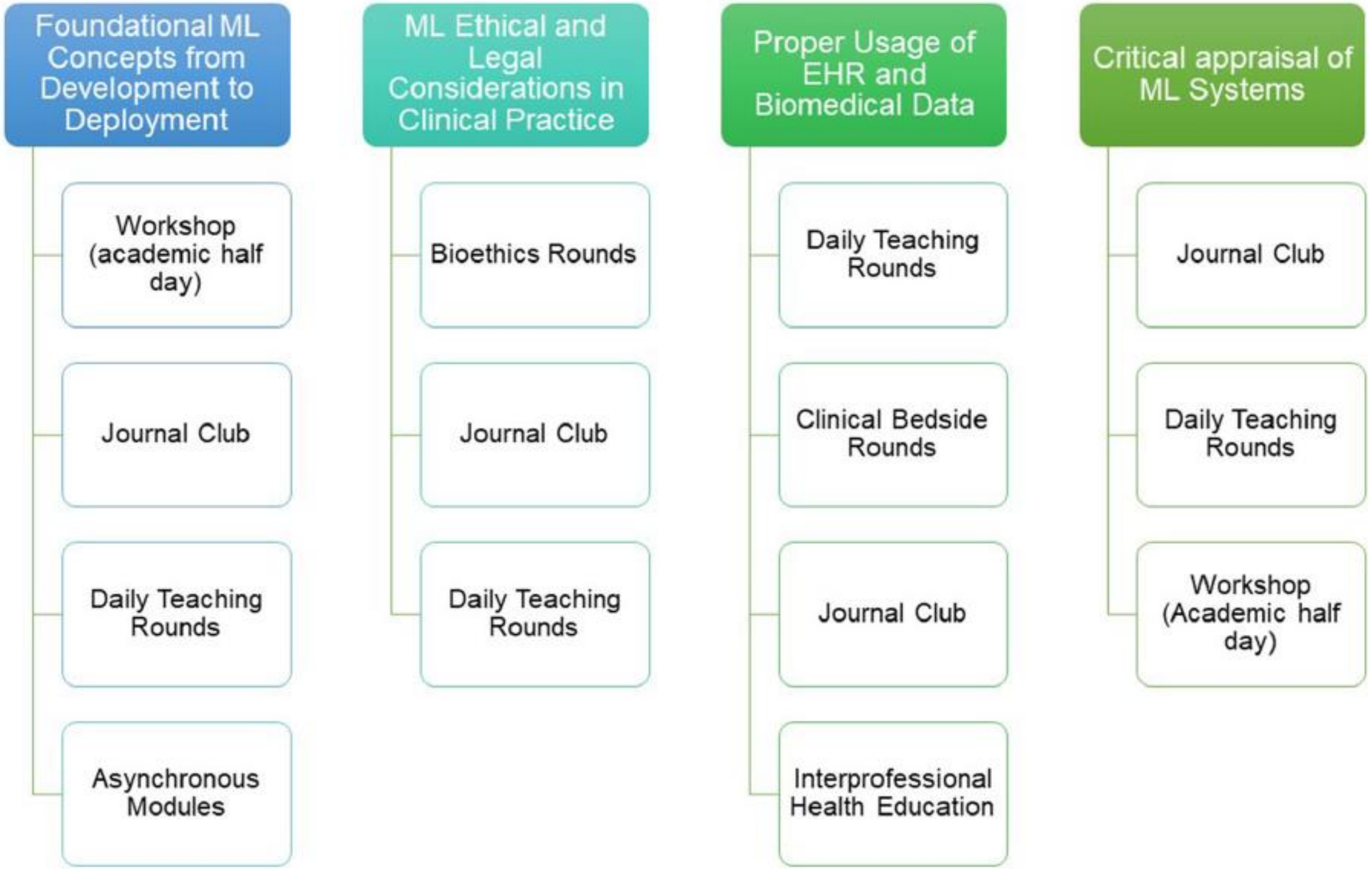


FIGURE 1 | One potential roadmap for leveraging existing curricular implementation resources common to many PCCM training programs. Resources are divided by the ML in PCCM curriculum objectives.

Intensivists face the daily challenge of making decisions based on the interpretation of constantly changing streams of data from both structured and unstructured sources

Structured data sources in the ICU include a patient's list of medical conditions, medications, serial vital sign metrics, laboratory data, fluid input/output measurements, mechanical ventilator parameters, life-support system requirements, therapeutic interventions, ECG, and ABG variables

Unstructured data include radiology reports, subjective bedside observations of clinical status, verbal conversations with family and allied caregivers, nursing notes, and a sub-specialist's notes in the medical record

Applying AI to analyse the vast amounts of data stored in an ICU's electronic medical record (EMR) could address this problem by revealing insights that improve patient outcomes and ICU resource management

Estimating disease severity and Predicting Patients Outcomes in ICU

Most intensivists do not use scoring systems outside of clinical trials, as they are often too complicated to use

They also tend to be derived from data of specific populations, limiting their generalizability

Lastly, every intensivist can share an anecdote of a patient fully recovering despite their clinical score predicting a 100% chance of death during their ICU stay, and vice versa

Estimating disease severity and Predicting Patients Outcomes in ICU

In a recent study, the ICU records of more than 400 hospitals and 200,000 patients across the USA were compiled with AI to evaluate new models for predicting mortality, which was 96% for in-hospital mortality and 99% for ICU mortality

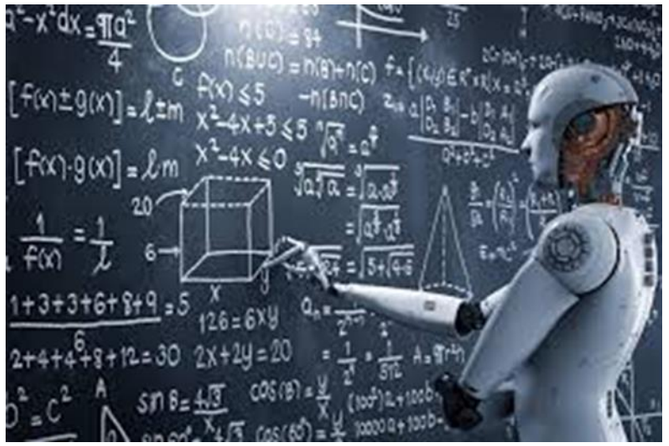
Would an intensivist rely on this AI-based prediction to justify withholding of life-support interventions in the name of futility ?

What effects would this information have on patients and their family members, if offered well in advance of their predicted deterioration?

AI in Pediatric Sepsis: Risk Detection

- A serious concern in pediatrics is the early diagnosis of Sepsis
- In a study of almost 500 PICU patients, AI detected severe sepsis as early as 8 hours prior to traditional EMR-based screening algorithms
- This efficiency can have a profound impact on the management of sepsis in the PICU
- allowing for earlier intervention and thus potentially reducing morbidity and mortality

Kamaleswaran R. et al. Applying artificial intelligence to identify physiomarkers predicting severe sepsis in the PICU. Pediatr Crit Care Med. 2018;19(10)e495-e503



AI in Sepsis: Risk Detection

- EWS tend to rely on clinical and laboratory parameters that develop later in the evolution of the sepsis syndrome
- When the initiation of treatments may no longer improve patient outcome
- Several investigators have tried to address this problem using AI specially in ER
- Relying on the hidden information contained within the waveforms of BP and ECG tracings, Mollura et al. built a model consisting of multiple decision trees to identify sepsis within the first hour of ICU stay

VITALITI™

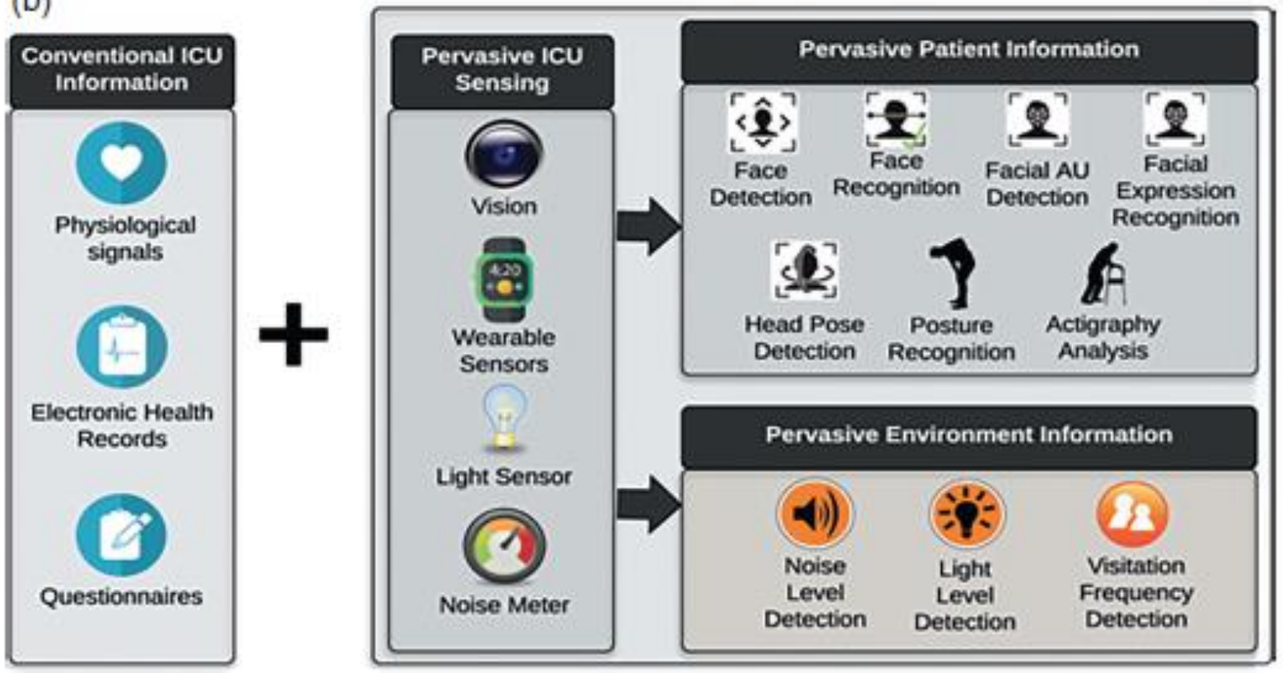
THE CONTINUOUS VITAL SIGN MONITOR

- Continuous Non-Invasive Blood Pressure
- Heart Rate
- ECG
- Respiration
- Acceleration
- Pulse Oxygen
- Core Temperature
- Body Position

Delirium Prediction

(a)

(b)



Enhancing Patient Monitoring with AI Technologies

Real time data analysis

AI systems can analyze patient data in real-time allowing for immediate detection of changes in patient conditions that require intervention

Predictive analytics for deterioration

By utilizing historical data and machine learning, AI can predict potential patient deterioration, enabling proactive treatment strategies

Improving Decision-Making Processes in PICU

- **Data-Driven Clinical Decisions**

AI assists clinicians by providing data-driven insights, helping them make informed decisions quickly, thereby improving patient outcomes

- **Personalized treatment plans**

AI algorithms can analyze individual patient data to recommend personalized treatment plans that cater to specific health needs and conditions

- **Reducing cognitive load of staff**

By automating routine tasks and data analysis, AI reduces the cognitive load on PICU staff, allowing them to focus on critical patient care.

Ethical Considerations and Challenges of AI in PICU

- **Ensuring Patient Privacy**

The integration of AI must prioritize patient privacy and data security, adhering to regulations to protect sensitive health information

- **Bias in AI Algorithms**

There is a risk of bias in AI algorithms based on the data they are trained on, which can lead to unfair treatment recommendations for certain populations

- **Training and Implementation Challenges**

Healthcare professionals must be adequately trained to use AI tools effectively, and the implementation process must be carefully managed to avoid disruptions

Streamlining Operations in Pediatric ICUs

- **Optimizing Resource Management**

  AI can analyze patient flow and resource usage, helping to ensure efficient allocation of staff and equipment in busy pediatric ICUs

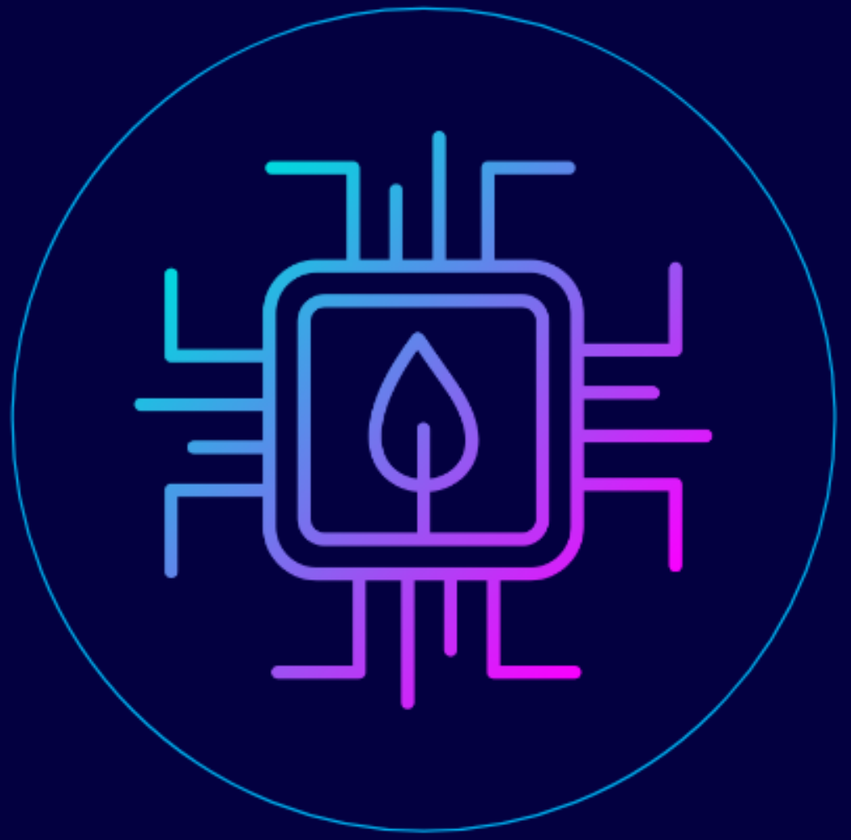
- **Enhancing Monitoring Systems**

  Machine learning algorithms can improve real-time monitoring systems, providing critical alerts for changes in patient conditions

- **Reducing Administrative Burdens**

  Automation of routine tasks using AI can free up healthcare professionals to focus more on patient care rather than paperwork

Training and Education for Healthcare Professionals



Integrating AI in Medical Training

Education programs can incorporate AI technologies, preparing future healthcare professionals to effectively use machine learning in their practice.

Continuous Learning Through AI Feedback

Machine learning tools can provide real-time feedback to practitioners, enhancing their skills and improving clinical decision-making.

Fostering Collaborative Learning Environments

AI can facilitate collaboration among healthcare teams, encouraging sharing of knowledge and experiences in pediatric care practices.

Evaluating the Consent Process for AI Usage

Informed Consent Challenges

The complexity of informed consent in pediatric care requires thorough explanations tailored to children and guardians, ensuring understanding of AI applications.

Parental Authority and Decision Making

Parents often make healthcare decisions for children, raising questions about their authority in consenting to AI interventions and data usage.

Assent from Minors

Obtaining assent from minors is crucial, as they may have differing levels of understanding about AI's role in their healthcare treatment.

Threats, dangers and benefits of AI

Negative views of AI’s impact on humans and society

Unintended consequences of AI, such as biased decision-making or the erosion of human agency. This type of conception can lead to a one-sided view of AI, and may cause individuals to underestimate its potential benefits and to overstate the risks and threats associated with its use

1

Unspecific fears about AI

Individuals tend to view AI somewhat binary, beneficial and dangerous simultaneously. Studies show that learners with a lower degree have a more negative outlook on AI. Learners with a higher degree have a more positive or a mixed view on threads and potential o

3

2

Lack of trust in AI due to absence of human qualities such as emotions and affect

Some consider AI impersonal, uncaring, or lacking in empathy. This may cause individuals to reject or be skeptical of AI-powered technologies and systems.

Can AI Solve All Healthcare Problems

Limited Scope

AI is a powerful tool, but it is not a panacea for all healthcare challenges. AI works best when applied to applied to specific, well-defined problems, and its capabilities are bounded by the quality and quantity of data quantity of data available.

Resource Constraints

The implementation and maintenance of AI systems in healthcare can be costly, and resource-constrained healthcare systems may face challenges in adopting and scaling AI solutions effectively.

Human Factors

Successful AI implementation in healthcare requires addressing human factors, such as user acceptance, acceptance, workflow integration, and the need for continuous training and support for healthcare healthcare professionals.

Ongoing Development

AI in healthcare is a rapidly evolving field, and continuous research, development, and refinement are refinement are necessary to address the complex and ever-changing challenges in the medical domain. domain.

Is AI Too Complex for Healthcare Professionals to Understand

1 2 3

Transparency

AI systems in healthcare should be be designed with transparency in in mind, providing clear explanations explanations of their decision-making processes and allowing healthcare professionals to understand and interpret the results. results.

Collaboration

Effective AI implementation in healthcare requires close collaboration between AI experts, experts, healthcare professionals, professionals, and IT teams to ensure ensure that the technology is well-well-integrated into clinical workflows and understood by all all users.

Continuous Learning

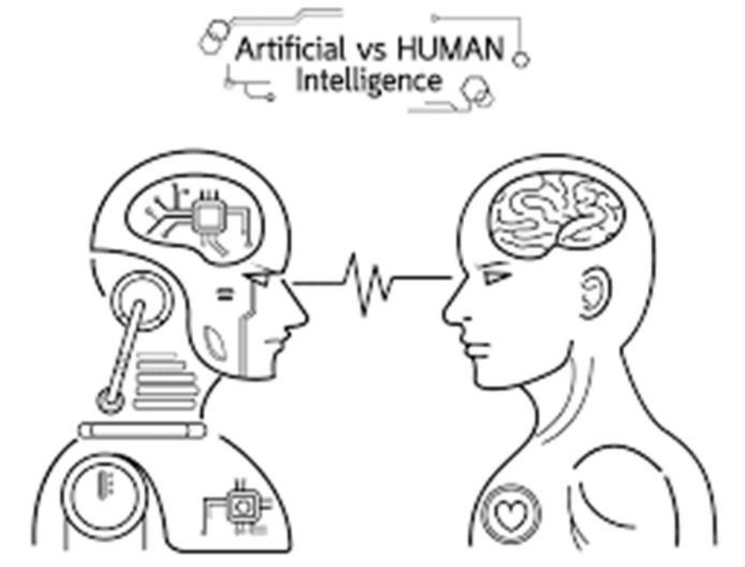
Healthcare professionals should be be provided with ongoing training training and support to develop their their understanding of AI technologies, enabling them to effectively leverage these tools to to improve patient care.

The Future

A realistic view of AI's role in the future of critical care by Komorowski

who is in fact one of the principal investigators of AI Clinician experiment

'I would argue that concerns around AI taking over
the jobs of physicians can be dispelled.
Awareness, multi-tasking, flexibility, and
communication skills are human capabilities that
no AI has achieved or seem likely to achieve anytime soon.
Instead, I foresee that AI will remain in the co-pilot seat,
improving our workflow and instilling more rationality into our practice'



Conclusion and Key Takeaways

1

AI Complements, Not Replaces

AI is a powerful tool that can enhance healthcare, but it should be viewed as a complement to human expertise, not a replacement for it.

2

Responsible Implementation

Careful consideration of ethical, privacy, and transparency issues is crucial for the responsible implementation of AI in healthcare.

3

Collaboration and Continuous Learning

Successful AI integration in healthcare requires close collaboration between AI experts, healthcare professionals, and IT teams, along with ongoing training and and support.

Any Questions