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INSIGHTS

Artificial intelligence in pediatrics: the future is now

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After 7 years of medical training, I had a minor epiphany sitting at the bedside of the premature infant recently placed on mechanical ventilation. I was watching an example of technology-driven automated weaning: a machine calculated and delivered the appropriate pressure to reach the lung tidal volume that I had targeted. As my patient's lung compliance improved with the administration of surfactant, the machine automatically adjusted and weaned the pressure. Gone were the days of frequent pneumothoraces and manual ventilator changes. I had previously believed that this type of advanced technology was only seen in movies as autonomous artificial intelligence (AI) software plotting to take over the world. Realizing that AI may not be a technology of the distant future, I began to wonder, should we and are we ready to incorporate AI into medicine?

As a millennial, I naturally used technology throughout my medical training. Web or mobile applications allowed me to provide evidence-based care to my patients. "Dr. UpToDate" and "Dr. Epocrates" helped me frequently when I needed a refresher on the recommended first-line therapy. For years, I depended on clinical decision support tools built into the electronic health record (EHR) to survive residency and keep patients safe. From the diabetic ketoacidosis order set that helped me to choose the correct titration of insulin and glucose infusions, to the alerts about dosing and ingredient interactions when ordering total parental nutrition, I relied on these tools to reduce medical errors.[1] While these are examples of "Augmented Intelligence" rather than "Artificial Intelligence", practicing medicine without the safety blanket of these technologies seems impossible.

Despite the term of Artificial Intelligence being introduced in the 1950s, AI's meaning has changed over time.[2] Artificial Intelligence generally refers to a computer algorithm that attempts to learn and perform tasks based on past experiences. Machine learning is a subset of AI that uses patterns seen in large datasets to maximize the desired output.[3] The appeal of these algorithms is that they may find novel associations in large datasets that clinicians previously had not considered.[4] For example, machine learning algorithms are currently being developed to predict autism spectrum disorders in high-risk patients using MRIs obtained at 6–12 months of age before autism can be diagnosed via symptomology.[5]

As you read this, the world continues to become progressively digitalized, resulting in changing expectations for health care delivery. As pediatricians, we frequently recommend that teenagers use their phones to download a menstrual tracking app, the MyPlate app, or a diabetes app that may help reduce hemoglobin A1C.[6] With advances in next-generation sequencing, new data continues to fuel precision medicine which enables personalized solutions to health problems.[7] Soon the complexity and scale of medical data will be beyond the capability of human cognition.[4] As a trainee, I worried about memorizing everything to provide the best care to my patients. Realistically, that expectation is unattainable. We are all years behind in reading, analyzing, and synthesizing the knowledge generated in the medical literature.

Recognizing that we are unable to keep up with the development of new knowledge and personalized medicine, augmenting our cognitive capabilities may be technology's and AI's crucial impact in pediatrics. We no longer depend on one doctor to deliver babies, perform surgeries, and manage chronic diseases; we practice as a team of specialists. Just as we use imaging technology to augment our medical decision making, it may be time to consider utilizing the knowledge gained through AI and clinical decision support to assist with complex clinical decisions.

Medical education has been slow to incorporate AI and Biomedical Informatics principles into its curriculum. Physicians will require a strong statistical understanding to scrutinize training datasets for potential biases and translate the meaning of AI-predicted probabilities into meaningful patient care. AI may provide "black box" decisions to clinicians without a clear explanation of the logic. Unless hospitals implement a knowledge management system that reviews AI or clinical decision support frequently, technology may encourage practicing biased or outdated medicine.

During my undergraduate training, I never considered that machine learning or AI would apply to my medical career. However, medicine is changing, and we cannot afford to be uninformed about technological advancements. Our patients are using technology at an accelerating pace. While I took typing classes in high school, today's middle schoolers take computer programing classes. Now parents and adolescents are receiving immediate access to patient portals to monitor and track their medical history online. In most clinical practices in the United States, paper documentation has become a page in the history books. While many complain about their complexities, the EHR is all I have ever been trained to use. Thus, panic sets in whenever I am on call during a scheduled EHR downtime. We have become dependent upon these technologies to provide patient care as demonstrated by hospitals that have experienced the chaos triggered by ransomware attacks or prolonged EHR downtimes.

Additionally, our patients are dependent on technology in their own lives and are frequently generating data from internet protocol (IP) enabled devices such as watches, phones, and blood pressure monitors to track their health and movements. From vitals monitoring to ventilator outputs, we are collecting "big data"

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at accelerating rates, and the exponential growth of the FDA approved AI algorithms will likely not slow down.

Are we ready for AI in pediatrics? Not completely, any review of the news headlines will reveal that there are still many issues such as unintended racial discrimination or underperforming sepsis algorithms. Rather, augmented intelligence should be the primary focus of implementation efforts and algorithms should focus on supporting humans rather than replacing them.[8] Instead of fighting this rapidly advancing field, we must build collaborations to help solve these issues and answer the questions we struggle with as clinicians. Just as the incorporation of medical devices has revolutionized our ability to save patients, the development of predictive algorithms may be the next frontier. We must begin to prepare for this new era of medical advancement as new AI technologies are rapidly being developed. As mentors, we should encourage medical trainees to seek ways to enhance their technology literacy. As pediatricians, we must become early adopters and embrace new ideas to catch up to the technology wave that has swept up our patients. As researchers, we should thoroughly test and evaluate these new tools to ensure they are improving patient outcomes.

While we are still far from the futuristic AI examples depicted in books and films, algorithms to detect early signs of sepsis[9] or automatically wean patients from ventilators[10] are currently being developed. Instead of viewing the EHR and AI as adversaries, we should use them to our advantage and create partnerships with the developers. Intuitive EHR designs that improve efficiency and algorithms that filter out the noise may finally provide the opportunity to re-focus our efforts on the most important variable in the medical equation: the patient.

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COMPETING INTERESTS

The author declares no competing interests.

CONSENT STATEMENT

Patient consent was not required for the completion of this work.

ADDITIONAL INFORMATION

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