Questions for Artificial Intelligence in Health Care

Artificial intelligence (AI) is gaining high visibility in the realm of health care innovation. Broadly defined, AI is a field of computer science that aims to mimic human intelligence with computer systems. This mimicry is accomplished through iterative, complex pattern matching, generally at a speed and scale that exceed human capability. Proponents suggest, often enthusiastically, that AI will revolutionize health care for patients and populations. However, key questions must be answered to translate its promise into action.

What Are the Right Tasks for AI in Health Care?
At its core, AI is a tool. Like all tools, it is better deployed for some tasks than for others. In particular, AI is best used when the primary task is identifying clinically useful patterns in large, high-dimensional data sets. Ideal data sets for AI also have accepted criterion standards that allow AI algorithms to “learn” within the data. For example, BRCA1 is a known genetic sequence linked to breast cancer, and AI algorithms can use that as the “source for truth” criterion when specifying models to predict breast cancer. With appropriate data, AI algorithms can identify subtle and complex associations that are unavailable with traditional analytic approaches, such as multiple small changes on a chest computed tomographic image that collectively indicate pneumonia. Such algorithms can be reliably trained to analyze these complex objects and process the data, images, or both at a high speed and scale. Early AI successes have been concentrated in image-intensive specialties, such as radiology, pathology, ophthalmology, and cardiology.2,3

However, many core tasks in health care, such as clinical risk prediction, diagnostics, and therapeutics, are more challenging for AI applications. For many clinical syndromes, such as heart failure or delirium, there is a lack of consensus about criterion standards on which to train AI algorithms. In addition, many AI techniques center on data classification rather than a probabilistic analytic approach; this focus may make AI output less suited to clinical questions that require probabilities to support clinical decision making.4 Moreover, AI-identified associations between patient characteristics and treatment outcomes are only correlations, not causative relationships. As such, results from these analyses are not appropriate for direct translation to clinical action, but rather serve as hypothesis generators for clinical trials and other techniques that directly assess cause-and-effect relationships.

What Are the Right Data for AI?
AI is most likely to succeed when used with high-quality data sources on which to “learn” and classify data in relation to outcomes. However, most clinical data, whether from electronic health records (EHRs) or medical billing claims, remain ill-defined and largely insufficient for effective exploitation by AI techniques. For example, EHR data on demographics, clinical conditions, and treatment plans are generally of low dimensionality and are recorded in limited, broad categorizations (eg, diabetes) that omit specificity (eg, duration, severity, and pathophysiologic mechanism). A potential approach to improving the dimensionality of clinical data sets could use natural language processing to analyze unstructured data, such as clinician notes. However, many natural language processing techniques are crude and the necessary amount of specificity is often absent from the clinical record.

Clinical data are also limited by potentially biased sampling. Because EHR data are collected during health care delivery (eg, clinic visits, hospitalizations), these data oversample sicker populations. Similarly, billing data overcapture conditions and treatments that are well-compensated under current payment mechanisms. A potential approach to overcome this issue may involve wearable sensors and other “quantified self” approaches to data collection outside of the health care system. However, many such efforts are also biased because they oversample the healthy, wealthy, and well. These biases can result in AI-generated analyses that produce flawed associations and insights that will likely fail to generalize beyond the population in which they are generated.5

What Is the Right Evidence Standard for AI?
Innovations in medications and medical devices are required to undergo extensive evaluation, often including randomized clinical trials and postmarketing surveillance, to validate clinical effectiveness and safety. If AI is to directly influence and improve clinical care delivery, then an analogous evidence standard is needed to demonstrate improved outcomes and a lack of unintended consequences. The evidence standard for AI tasks is currently ill-defined but likely should be proportionate to the task at hand. For example, validating the accuracy of AI-enabled imaging applications against current quality standards for traditional imaging is likely sufficient for clinical use. However, as AI applications move to prediction, diagnosis, and treatment, the standard for proof should be significantly higher.6 To this end, the US Food and Drug Administration is actively considering how best to regulate AI-fueled innovations in care delivery.
At the heart of all this lies a paradox: the promise of AI to augment and empower clinicians is intertwined with the risk it poses to patients, especially those with life-threatening diseases. The potential of AI to streamline care and reduce costs is undeniable. However, the hype of AI and missing the realization of its potential.

A Balanced View of AI

AI is a promising tool for health care, and efforts should continue to bring innovations such as AI to clinical care delivery. However, inconsistent data quality, limited evidence supporting the clinical efficacy of AI, and lack of clarity about the effective integration of AI into clinical workflow are significant issues that threaten its application. Whether AI will ultimately improve quality of care at reasonable cost remains an unanswered, but critical, question. Without the difficult work needed to address these issues, the medical community risks falling prey to the hype of AI and missing the realization of its potential.