

Preference-Sensitive Decision Support and Care Pathway Personalisation: AI-Driven Tools for Advancing Patient-Centred Clinical Care Models

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1. Introduction to Patient-Centered Care and the Need for Personalized Treatment Approaches

Patient-centered care has become an important focal point in healthcare. Patients and families are now seen as essential members of an interprofessional care team collaborating toward recovery and health maintenance. People have highlighted the need for care that takes their preferences, values, and culture into account. As such, the healthcare profession has shifted from a one-size-fits-all model to one that attempts to take individual differences into account. Concerns such as ethnicity, race, beliefs, and certain aspects of a group or individual's socioeconomic status must now be considered when making care plans. Shortfalls in patient-centered care are evident in vulnerable and minority populations. Minority groups are skeptical of healthcare, feel misunderstood, and have a lower probability of receiving optimal care as a result.

These trends are important because the United States is aging and becoming more diverse, with greater demand for person-centered, efficient, safe, and effective healthcare. Older adults and people with chronic illnesses have the greatest need for healthcare resources. The divide between benefits and costs widens as the number and severity of treatment options available increases. Individuals are more likely to choose healthcare options that are consistent with their values and goals when they are well informed and understand that only a relative benefit may exist. There is an upsurge of discussions on precision medicine, personalized treatment, and global environmental health as the rise of science investigates various cellular types, organs, and systems. These trends mark the beginning of a cultural change requiring increased use of interprofessional teams and 'just right' therapeutics tailored to the specific genetic,

anatomical, and life circumstances of each person. Advanced technologies, including robotics, telehealth, informatics, and artificial intelligence that includes machine learning and predictive modeling, are means to coordinate this breadth of provider assessments. Given these trends, integrating the best practice evidence for each type of provider and patient will continue to be relevant. A trend analysis also suggests a dearth of evidence on AI-driven systems in relation to coordinated self-management care for adult populations.

2. Fundamentals of Machine Learning and AI in Healthcare

Introduction of Machine Learning and AI in Healthcare Unpacking the use of machine learning and AI in healthcare begins with a basic understanding of how it works. Machine learning and AI can take large sets of data and look for patterns, changes, and trends, or it can make predictions. In general, the way big data works is to separate the wheat from the chaff; that is, it tries to find things that are out of the ordinary. It does this by using something called an algorithm, which is a set of rules a computer uses to make decisions. In AI and machine learning, the algorithm is 'trained' with data so that it can learn how to make a decision. Then, it works the same way as human learning does — it gets more examples to learn from, and it tries to get better at making its decisions. The more data the system has to learn from, the better the system can predict the answer. Supervised learning is where the computer has lots of examples where it already knows the answers. It can then find patterns or associations that relate to the answers. Once the machine has been trained, it presents some new data, and it can predict the answer to that data. Unsupervised learning is where the machine has lots of data, and it looks for associations that exist in the data. Then it uses the associations to split the data down into parts. This might be as simple as looking at who has cancer and who does not, and then looking at the different things they do. In healthcare, supervised learning might use a training set of images that have had a clinical decision, like 'has cancer' or 'does not have cancer', with an area on the image highlighted to show where the cancer is. The system would use the highlighted areas to find some of the associations and then predict where the cancer is in new images. Similarly, it might predict response to certain cancer treatments based on inputs like test results and imaging features. Unsupervised learning may, for example, use gait measurements, brain imaging, plus other patient data to split a population into different subgroups that need different types of management.

3. Applications of AI in Developing Personalized Treatment Approaches

As an advanced digital technology, AI has various applications that contribute to the development of personalized treatment strategies. Genomic data contains a treasure trove of information, which, when deciphered, can become a vital component of precision healthcare. AI can analyze genetic information and provide healthcare professionals with insights into potentials for personalized drug regimens, patient risk stratification, outcome predictions in clinical trials, or tailored clinical practice guidelines. Driven by AI, precision medicine can match patients based on similar personal genetic, phenotypic, or cognitive features and demonstrate the most favorable responses to therapeutic outcomes. As a common base in research, electronic health records contain patient histories that can be analyzed retrospectively to inform predictive and personalized patient care models. AI offers predictive analytics that can be applied to EHR data to assess patient management strategies based on historical data patterns.

AI can support patient care through the development of predictive or diagnostic models. Harnessing knowledge learned from historical patient care activities, risks of chronic disease progression can be predicted, and management strategies derived that are novel, patient-centered, and offer an alternative to standard care pathways. AI-driven and evidence-based decision support tools use patient data and clinical outcomes to determine the most beneficial treatment options for an individual patient. However, despite these potential advantages, there are a number of challenges that could limit their widespread introduction to standard clinical practice. Large-scale patient and clinical data are required to build accurate algorithms. Therefore, if AI-driven personalized care tools are to become common practice, data curation, quality, and governance issues must be addressed, and a national shared clinical decision-making platform needs to be established. Full transparency of data sources and AI algorithms requires clarification, and social and ethical acceptability will need to be assessed.

4. Enhancing Patient Satisfaction through AI-Driven Tools

Let's concentrate on how AI-driven tools are enhancing patient satisfaction. Patient satisfaction and patient experience are some of the most important quality of care factors for a healthcare organization, and improved patient satisfaction is now tied to reimbursement for many hospitals. As reimbursement becomes more pay-for-

performance, many healthcare organizations are focusing on the patient experience and turning to predictive and health AI-powered tools to assist them in doing so. With more than 80% of healthcare consumers using digital devices and 67% using digital communication to monitor and improve their health, healthcare providers have been slowly but increasingly working to improve digital communication between patients and providers.

AI-driven tools make it possible for customers to chat in real time as well as interact with virtual assistants to get real-time information. Features of customer care chatbots and virtual assistants include auto chat, sentiment analysis, intention recognition, and voice engagement. Rather than having patients call an office only to be placed on hold, any inquiries can be answered immediately. Virtual assistants trained in Natural Language Processing can be positioned both as web and/or mobile applications and also as SMS chatbots. They can inform and message the patients about visiting hours, give information on services in their health plan, and even remind them when to refill medicine. Not only that, but virtual assistants can also personalize each interaction to make it more relevant and pleasant. Features can be adjusted to include a pleasant name, and the ambience is set to uplift the patients. A virtual assistant is set up to ask the right questions, propel the patient forward, and help them out. Even artificial intelligence tools that analyze data and show patient satisfaction scores are being used. Fixing problems in real time exudes efficiency. Because it analyzes feedback from patients in both channels - digital and manual - periodically, changes can be made in real time. In review, this one tool has been able to streamline services within a hospital based on patient interactions. The cost of capital for the hospital system was less than 1% of the revenue gained from the improvement in patient experience. Along with chatbots and virtual assistants, the customer care tools that analyze demonstrated prosperity and provide optimal satisfaction have quickly gathered the attention of care providers. It provides patient sentiment throughout real-time interaction with chat features, calls, or wait times. Recognizing weak points on demand among patients helped facilitate patient registration in multiple environments. Along with tracking the sentiment of each patient, the system also traced the veracity of a patient's contact information, set up their communication preferences in a personal portal under the health plan, and pulled in consent, making it a complete solution valuable to the organization. So, with patient sentiment driving toward an increase in revenues and the development of a

fundamental health AI-powered tool enabling quick, life-saving care, one should anticipate the role of healthful personalization and strategies in promoting that. Keeping the focus on each individual patient is expected to drive competitive advantage, satisfaction, and quality for any organization that adopts it.

5. Challenges and Ethical Considerations in Implementing AI for Patient-Centered Care

AI is not a silver bullet and is not always the best tool for the job. AI cannot control or influence human behavior, cannot become as emotionally involved or as attached to the stakeholders, and therefore it should not completely replace or undermine the human aspect of caregiving. The elegance of holistic patient-centered care is often diluted once technology and mechanistic logic invade it. On the other hand, AI technologies integrated within healthcare systems need to adhere to data protection requirements protecting patient health-related data. Ethical considerations are required to guide the development and implementation of AI-driven systems to ensure that AI serves humans, in domains such as healthcare, aligns with the highest international ethical principles.

The application of AI in healthcare generates many legal and regulatory challenges. The recent breakthroughs in AI shifted the discussion from the ethical and societal concerns related to the principles of harm, justice, and autonomy to the dangers and implications of algorithmic bias, particularly in health assessment where AI-driven decisions can sometimes be detrimental to some groups of individuals. Because of its black-box nature, AI may result in uncorrectable choices and partially automate medical decision-making based on conflicting and multifactorial criteria. The nature of AI-driven technologies raises the question of how to set up a system of explanation for patients as well as for health professionals. Ensuring transparency is key in an AI ethics framework; otherwise, all kinds of decisions affecting individuals in different ways could be made. It is therefore crucial that not only computer scientists and tech enterprises be part of the discussion about AI, but also numerous stakeholders representing different backgrounds and knowledge. The co-conception and incorporation of ethical rules at the inception of AI in diverse areas of human life may provide guidelines on the desirability to reformulate such devices in view of the common good. Hence, the adoption of a multidisciplinary approach in the design of AI systems is imperative. In summary, AI

integrated within medical decision-making can play a significant role, which should improve healthcare at the patient level through reducing diagnostic uncertainty, enhancing healthcare delivery, identifying therapeutic avenues for research and discovery, and ensuring that medical resources, particularly in low- to medium-income countries, are optimized.

6. Future Direction

AI-Driven Tools Integrated with Telehealth Services: A trend that is expected and hoped to sustain moving forward is the recent surge in the use of telehealth services. Telehealth services, when further combined with AI and machine learning, may be used to bring personalized patient-centered care plans closer than ever for many individuals. This may represent a relatively low-hurdle approach to ensuring that resources and care are as personalized as possible for the broadest number of patients.

AI that Can Learn Over Time: Successfully incorporating advances in the field of AI, data-driven, patient-centered models that represent the future of healthcare will require systems that can continuously learn and adapt in a perpetually changing world. For AI systems in care settings, this means learning not only from experience with patients but also from newly published medical literature, device instruction manuals, electronic health record functionality, and others to incorporate customized care best practices that keep pace with a continually evolving patient population and body of medical knowledge.

Patients and Their Health: One Step Ahead: The impact of personalized AI, data-driven tools for patients is vast. From the development of real-time applications that alert patients to 'red flags' to work smarter, more collaborative care programs, AI and machine learning can and should be all about the patient.

True Translational Integration: Bringing AI into the mainstream of healthcare service decision-making is inherently an interdisciplinary effort that benefits from deep, meaningful, and product-level collaborations upstream across commercial and academic medicine, research, product development, and regulatory professionals.

Political Sprints: Just as the physical infrastructure of our country needs renewal and refurbishment to make the future better than it is now, so too does the acceleration of patient-centric health technology. The key to exerting progress is an enduring partnership between the U.S. Congress, the Personalized Medicine Coalition, which brings the private and public sectors together, and the agencies and organizations that

write and enforce the rules. Legal Avenues: Ongoing interdisciplinary collaboration and a globalized, data-driven healthcare landscape call for a uniformly ethical and responsible AI systems framework that accommodates ongoing cycles of learning, feedback, transparency, and enforcement. AI is Only a Tool: In order for AI in healthcare to successfully pivot healthcare and healthcare research innovations to better meet the needs of patients, the tools that are created must be optimized from the very beginning to empower and respect the individual, the patient. Patient empowerment through tool development must be a goal, not an afterthought, and should focus on enabling and motivating shared decision-making in care, increasing patient engagement, opening access to technology, and meeting the need for flexible, manageable, precise, protected relationships with these smarter, real-time tools.

7. Conclusion

7. Conclusion: While AI holds great promise for patient care, the ethical considerations and challenges must be addressed to harness its full potential. The goal of personalizing healthcare to meet unique patient needs in an efficient and effective way makes the use of AI ideal. Personalizing care will continue to be more important as the rising generation demands healthcare solutions that meet their unique needs. Research over the years has shown that both the feeling of control and understanding the condition lead to greater satisfaction with the entire experience. Both of these elements are necessary for patients to feel they are getting a personalized and patient-centered approach. Engagement of the consumer is critical to the success of the system. It is evident that this area of research is new with continuing technological advancements. Future research will be important to understand how consumer preferences will change and how the system can continue to evolve to match those changing requirements. As healthcare continues to become more consumer-driven, the methods used to care for those consumers will continue to evolve. We, therefore, suggest a cautionary but optimistic view. If developed and employed wisely, AI-driven solutions can enhance the experience of patients and their families while improving patient health outcomes. The journey for AI and patient care is just beginning.