

Disease Prognosis and Tribal Medicine: Opportunities for Integrating Indigenous Healthcare Knowledge with AI-Based Clinical Decision Systems

Sravanthi V¹, Prof. T. Sobha Rani²

¹Research Scholar, Department of Business Management, Sri Padmavati Mahila
Visvavidyalayam, Tirupati

²Professor, Department of Communication & Journalism, Sri Padmavati Mahila
Visvavidyalayam, Tirupati

Abstract

The rising number of noncommunicable diseases (NCDs) among tribal communities have become a major public health issue not only throughout India but also in many developing countries today. Historically, tribal health care systems have been based upon traditional medicinal knowledge; ethnomedicine practices; and the healing traditions of their communities; which have developed over many generations within their respective ecological environments through interactions between people and nature. Although tribal communities continue to rely heavily on traditional medicine for their health care needs, contemporary health care policies and technology focus primarily on biomedical approaches to treating disease and disregard, to a large extent, the traditional knowledge base relating to the use of indigenous medicinal practices. At the same time that there have been significant advances in artificial intelligence (AI), machine learning (ML), and clinical decision support systems (CDSSs), which have changed and improved how diseases are diagnosed, treated, and managed globally, there have been few if any studies examining the extent to which these types of AI-based health care technologies have been, or can be, utilized within tribal contexts. Most existing studies on tribal medicine and AI-based health care have treated both subjects as completely separate and independent fields of study, resulting in conceptual and practical gaps in the medical literature on these topics. This review of the literature examines scholarly articles and papers on the relationship between tribal medicine, disease diagnosis and prognosis, indigenous health care knowledge and health disparities in tribal communities, and AI-based clinical decision systems. The findings of this review support the conclusion that tribal medicine should not be construed solely as an ancient or traditional form of medicine; rather, tribal medicine is a continually evolving knowledge system capable of providing relevant insight into modern approaches toward managing the health of contemporary society. In addition, this research paper examines how to integrate traditional indigenous healing practices with AI technologies to improve predictive modelling, access to healthcare, and equitable outcomes in medicine for under-served native communities. The researchers found many deficiencies in terms of including traditional knowledge in AI systems, creating a need for frameworks that address cultural sharing, ethical grounding, and social

inclusion in the design and use of health care technology. Overall, researchers concluded that the future of tribal health care will require interdisciplinary solutions for connecting conventional healing methods with new digital health technologies.

Keywords: Tribal medicine, disease prognosis, indigenous healthcare knowledge, artificial intelligence, clinical decision support systems, tribal health, healthcare inequalities, ethnomedicine.

1. Introduction:

The importance of health cannot be overstated as it is central to the development of individual well being, to the productivity of the society, to the economic development of the community and to the continued existence of the culture. Every civilization has developed its own distinctive health care knowledge system based on its natural environment, cultural beliefs, and collective understanding of disease and healing.

For indigenous and tribal populations, the means by which their health care originated can be traced to the interaction over thousands of years with their forests, the medicinal plants of their forests, and with their local biological environments and the transmission of this information from generation to generation through their communities.

Indigenous health care practices continue to be a significant part of the daily health care of millions of tribal people around the world.

The tribal populations in India are among many of the most disenfranchised as a social and geographical group in association with the tribal concepts defined by the treatment of the Constitution; that being; Scheduled Tribes; that make up a great number of Indigenous peoples within each Tribe that are recognized by many various categorically distinct communities based on their unique cultural practices, traditional means of livelihood, language, reliance on natural resources, etc. Tribal populations continue to experience significant and pervasive differences in access and opportunity in regards to health care, education, infrastructure, and socioeconomic status despite numerous and continuing constitutional and welfare initiatives that support, protect, or facilitate the opportunities available to them (Mohindra & Labonté, 2010).

Until recently, most of the discussions concerning health and community have focused primarily on maternal mortality, infectious disease, malnutrition, anaemia and insufficient health care services. However, in what can be described as an interesting change, virtually all the current literature on tribal communities reports evidence of an epidemiological transition in the form of increased NCD (non-communicable disease) burden; that is to say, communities that were once predominantly affected by various infectious diseases are now also experiencing extremely high burdens of the following NCDs: diabetes Mellitus, hypertension, cardiovascular disease, chronic lung disease and cancer (Kaur et al., 2022). This change is occurring as a consequence of various social, economic, and environmental changes affecting all aspects of tribal society.

Noncommunicable diseases among tribes are a particular type of challenge for health systems. In contrast to acute diseases that require a short-term (maybe weeks) intervention, treating chronic diseases requires long-term monitoring, long-term treatment, lifestyle modifications, and interventions to help identify people at risk.

Many tribes are also found to have an insufficient number of health professionals, lack enough diagnostic equipment, have sub-optimal transportation infrastructure, and have limited access to specialized health services. This means that disease is diagnosed at a very advanced stage, when it is more difficult and costly to treat. The notion of 'disease prognosis' now represents an important part of managing the delivery of care in publicly funded Healthcare Systems across Canada, particularly in relation to disease progress, the likelihood of achieving successful treatment outcomes and the potential for developing health-related problems in the future based on clinical/behavioural data and information available at the time of diagnosis.

The increased capacity to perform effective prognostic assessment allows health care professionals to better identify at-risk individuals, develop preventive strategies and improve long term health outcomes by informing effective health care delivery. Recently, through technological innovations such as the incorporation of AI, machine learning, predictive analytics and CDSS into clinical practice, there has been a marked improvement in the ability of health care professionals and organizations to perform timely, accurate and reliable prognostic assessments.

The utilization of Artificial Intelligence in the healthcare system has indeed changed the landscape of healthcare by allowing for the use of large amounts of data to analyze and identify patterns of healthcare and predicting outcomes to assist physicians' decisions. AI technology continues to grow and has become an essential part of disease prediction, patient monitoring, as well as assessing risk, aiding in diagnosing, and planning for treatment options. Many authors have noted that AI has the potential to make healthcare more accessible globally, especially in areas where access to providers or specialized care is limited (Bompelli et al., 2021).

Despite the rapid advancement of AI and infrastructure, there remains one primary question that has gone unaddressed in the literature regarding AI in health, namely how does indigenous knowledge of healthcare inform the AI predictive capabilities surrounding diseases? Most technology today related to healthcare is developed based upon the use of biomedical information from hospitals, clinical laboratories, and institutional healthcare facilities; whereas indigenous knowledge of healthcare, including ethnobotanical uses of plants, uses of traditional diagnosis, and community-based observation are found to be absent from the majority of healthcare technology developed today.

The implications of this oversight can be interpreted in both ethical and conceptual ways. Tribal medicine includes hundreds of years' worth of collective wisdom associated with health and illness, how we relate to our environment, natural remedies, and ways to repair and maintain the body. Yet, tribal medicine is often viewed as a cultural tradition in the context of healthcare today rather than a valid source of healthcare knowledge or information during discussions of modern-day health care. This creates an unequal balance between how

we perceive tribal medicine as inferior to the scientific challenges presented by modern medicine, therefore creating a dichotomy between scientific evidence for health (biomedicine) versus anecdotal and non-scientific evidence for health (traditional tribal medicine).

If the literature is examined critically regarding the relationship between Tribal Medicine and Modern Medicine, generally there are two opposing sides to how these systems of care have been compared and contrasted. Traditional Medicine systems are often considered as options to modern technological innovations in managing health care needs and using these health care systems exclusively. This type of comparison fails to recognize that both systems of acquiring knowledge regarding health care may have meaningful contributions to improve health care outcomes. There continues to be an increased need to explore how Indigenous Medicine and Artificial Intelligence (AI) can work together toward a common goal of achieving health care access to all populations through inclusive health care systems.

Much existing research suggest that there is a significant lack of interdisciplinary research regarding the connection between tribal medicine, disease prognosis and artificial intelligence. Many researchers have published ethnomedicinal practices and issues faced by tribal peoples, however, through the limited amount of published research there is only a small number of articles examining if/how indigenous knowledge will assist in developing predictive healthcare models. Similarly, the overwhelming majority of Artificial Intelligence related healthcare research has been conducted with a focus on urban populations and in institutional healthcare environments using either biomedical datasets or electronic health records and has minimally addressed using an indigenous healthcare system or to support marginalized communities.

The purpose of this review article is to begin to address the lack of research connecting tribal medicine, disease prognosis, and AI-based healthcare technologies by examining the intersections of these areas in- depth. Rather than treating indigenous knowledge and modern technology as separate entities, this article is exploring options for how the two areas can be integrated to create new opportunities for developing an innovative future in healthcare. This article will present a case for developing an innovative future in healthcare that includes ethical recognition, inclusion and integration of the vast knowledge that exists in these two areas.

By providing a synthesis of the literature in the areas of tribal studies, public health, ethnomedicine, healthcare management and artificial intelligence, this review is intended to contribute to the ongoing policy and practice discussions regarding the development of inclusive healthcare systems. Furthermore this article will provide a conceptual framework to support the use of culturally relevant clinical decision making systems based on Artificial Intelligence technologies that can enhance disease prognosis for tribal peoples; and to support the development of culturally responsive clinical decision systems for artificial Intelligence technologies through continued research.

Objective of this review:

- To investigate how traditional medicine and local health knowledge are being applied to solve healthcare problems within tribal populations.

- To assess how disease prognosis impacts access to treatment/medication and formalized practices within tribal populations, particularly as non-communicable diseases continue to grow exponentially, thereby also causing greater discrimination within formal healthcare systems.
- To provide an analysis of the implementation of Artificial Intelligence (AI) and Clinical Decision Support Systems (CDSS) for predicting, diagnosing, and managing illness, as well as how these technologies will shape future practices for addressing Indigenous healthcare needs.
- To identify potential opportunities and barriers to implementing Indigenous health knowledge and AI-based CDSS in order to provide fully inclusive healthcare for tribal populations by performing a health services gap analysis.

2. Conceptual Understanding of Tribal Medicine and Disease Prognosis

2.1 Tribal Medicine as an Indigenous Knowledge System

Tribal medicine is among the earliest forms of healing available to people, and it is still practiced today within indigenous societies throughout the globe. Tribal medicine incorporates all forms of healing (medicinal herbs, herbal remedies, spiritual healing, rituals, bone-setting & community-based medicine), while modern biomedical healthcare relies on laboratory-based diagnostic systems and evidence-based treatment protocols. Tribal medicines are based on many decades' worth of knowledge acquired through culturally-based traditions, environmental awareness and experiential learning (Sood et al., 2019).

Many researchers assert that we should not see native healthcare systems like tribal medicines as a simple grouping of "herbal remedies" or "folk medicines," but rather as a sophisticated healthcare system created by continual interactions between people within their environment (Mondal and Bhattacharya, 2023). A considerable amount of knowledge exists throughout all Tribal communities held by traditional healers regarding the local plant species and how they can be used to identify potential disease-causing organism and how to treat disease through both preventative action and medical treatment. Thus, in Tribal culture, health is viewed holistically (i.e., a person is healthy & well when their body/heart/ mind is connected to the universe humans, communities, nature, spiritual world).

At present, the current medical community is conflicted regarding tribal medicine's place in the conversation surrounding modern healthcare. Many ethnobotanists and anthropologists identify the cultural importance of tribal medicine; however, indigenous healthcare systems are frequently marginalized from public health policy by biomedical models (Negi & Azeez, 2022). This marginalization reflects a greater power dynamic concerning what type of medical knowledge is acceptable, thus limiting the potential for tribal medicine to be viewed as a source of contribution rather than just a means by which to maintain and protect tradition.

The literature regarding tribal medicine demonstrates the limitations of this perspective on interdisciplinary healthcare development. By defining tribal medicine as strictly a cultural resource, researchers can overlook its practicality for understanding health behavior, diseases, and community-based responses to healthcare. Because of this, there is a need for tribal

medicine to be identified as a knowledge base that can inform current healthcare research and practice, in addition to being viewed as a cultural resource.

2.2 Understanding Disease Prognosis

Regardless, modern-day disease prognostic models continue to rely heavily upon' medical information as their primary resources for developing predictive models for diseases.

Specific data sources include clinical recordkeeping / patient history, lab tests, imaging studies/animals, and hospital dataset and trends.

Local healthcare observations or community accounts and traditional forms of evaluation do not receive significant respect when ceating models from these primary resource centers.

Therefore, it begs the larger question; is it possible to provide comprehensive disease prognosis if some type of healthcare information from a local/indigenous perspective is excluded/rejected?

To date, there are limited academic writings specifically addressing this issue within the current literature. There is much opportunity for an increased perspective of providing supported, equitable evidence based predictions that are developed collaboratively between providers and other stakeholders in health services.

2.3 The link between tribal healing and prognosis of disease:

Tribal healing and prognosis of disease are commonly discussed as separate subjects; however, the two subjects are fundamentally similar in terms of being concerned with understanding, preventing, and managing illness. Traditional healers often utilize accumulated experiential knowledge to identify symptoms of illness, predict the course of an illness and identify prevention strategies. Most traditional diagnostic techniques by indigenous healers rely upon observing changes in behavior, differences in the environment, eating habits, and the health experiences of the community (Sood et al., 2019).

From a contemporary standpoint, these techniques can be viewed as localized forms of predicting health status. Although the two forms of prognosis are considerably different from each other, they are both systematic methods of predicting potential health disparities and the future outcome of potential health issues in a specific cultural environment.

Sadly, tribal medicine has not been adequately explored in the scholarly literature as related to prognosis of disease. Scholarship is primarily focused on exploring medicinal plants, healing rituals and beliefs about how to provide healthcare; however, the prediction of disease and health risks by indigenous healers has received little attention (Sood et al., 2019). As a result, a critical area of tribal health knowledge has been under-explored.

The increasing demand for predictive health technologies provides an opportunity for re-examining the relationship between these two fields: traditional medical practice versus the prognoses (predictions about the outcome) of diseases. Future studies could explore the connections between Indigenous observations, community knowledge, and traditional methods of health care regarding how they can assist in understanding the progression and prevention of disease.

2.4 Developing a Better Understanding of Inclusive Knowledge in Healthcare

An ongoing problem in today's healthcare research is how to include many different types of knowledge in the healthcare field. The majority of healthcare systems are organized in a hierarchy that gives priority, or higher value, to established scientific knowledge and institutional knowledge than to local and traditional indigenous knowledge. This hierarchy has implications for the way that healthcare systems choose policies, set research priorities for funding, and create new technologies.

Artificial Intelligence is an area of great concern in this regard. AI is a system that learns by analyzing large amounts of data. Most of the data that AI analyzes comes from databases, which means that the predictions made by AI about healthcare depend as much on the amount of healthcare-related information included in the databases as they do on how representative that information is. For example, if the databases used by AI to generate predictions about the future health outcomes of tribal populations do not have enough tribal people represented within them, then the predictions generated by AI may not factor in the unique cultural, environmental, and human factors that shape the health of tribal communities.

In addition to being an issue for predicting the future of health for tribal communities, the inability of AI to accurately predict the health of tribal communities raises the question of the social equity and justice provided by healthcare innovation. An increasing number of people argue that healthcare innovations cannot just be measured based on how technologically sophisticated they are, but instead must be measured based on how effective the innovations are at reducing social inequities and using diverse forms of knowledge (Mohindra & Labonté, 2010).

Thus, the prospect for disease prediction via artificial intelligence could be better achieved through a more inclusive understanding of the different types of knowledge that exist within the healthcare realm and the equal value that must be accorded to both the knowledge found in traditional indigenous healthcare practices, as well as in the knowledge produced with modern technology. This approach will challenge conventional notions of the dichotomy between traditional vs modernity and the associated hierarchy that values modern healthcare knowledge over traditional indigenous healthcare knowledge.

3. Literature Review

3.1 Tribal Medicine as a Knowledge System - Beyond Ethnographic Accounts

Groups all across the globe have used different traditional methods or forms of medicine for centuries. They have used them for physical, emotional and spiritual healing purposes. There are currently many tribes throughout the world that practice traditional methods of medicine. There has been much written about these types of traditional forms of medicine within the last 20 years. Many of the writings on this subject are within the areas of ethnobotany, anthropology and public health and have focused on the following areas: medicinal plants, healing rituals, indigenous therapeutic practices and the significance of traditional healthcare systems (Sood et al., 2019).

While the above-mentioned areas of study have been helpful in recording the knowledge possessed by tribes, it should be noted that many of the studies being conducted are descriptive only, and do not offer critical evaluations of the knowledge that tribes have about healthcare and healthcare practices. Researchers are conducting studies on what tribes know, but do not present any evidence to support a potential for any type of contribution of the knowledge of healthcare that tribes have to the development of new healthcare solutions. Therefore, tribal medicine is often viewed as a valuable repository of historical knowledge, rather than as a valuable resource for developing new healthcare solutions.

3.2. The Emerging Burden of Non communicable Disease and Tribal Health

Tribal health in India has long been associated mainly with communicable diseases, malnutrition, maternal mortality and a lack of sanitation. This association has shaped public health policies and academic research related to tribal health. However, recent studies show that tribal populations in India are increasingly experiencing a significant increase in non-communicable diseases (NCDs), indicating that there is a deeper epidemiological transition in indigenous peoples (Kaur et. al, 2022; Sathiyarayanan et. al, 2019).

Scholars have explained the reasons for this transition from communicable to NCDs as associated primarily with rapid socioeconomic and environmental change. For example, increasing market integration, changes in diet, decreased physical activity, migration, and exposure to fast food combined with the increased use of alcohol and tobacco have adversely affected traditional lifestyles, which historically provided tribal populations protection against many chronic diseases (Sathiyarayanan et al., 2019). With the increasing integration of tribal peoples into mainstream economic systems, tribal communities are also increasingly at risk for health problems associated with modernity.

However, a close reading of the literature suggests that many authors attribute NCD prevalence to lifestyle changes alone. Although these explanations are important, they are frequently too simplistic to reflect the complexity of tribal health realities. When authors focus on individual lifestyle choices, they may inadvertently ignore the structural determinants of tribal health, including poverty, health care exclusion, land displacement, environmental degradation, and development.

Devi et al. (2025) presents an argument that chronic disease rates amongst tribal groups should be examined from the perspective of the larger model of social determinants of health, whereby people's health outcomes are shaped by not only personal behaviors but also their access to education, health care, money, and social opportunities. Because of the continued use of various methods of marginalization by many tribal groups today, it is particularly important to understand the social determinants influencing their ability to prevent, diagnose, and manage chronic diseases.

Also limiting the generalizability of findings in current literature is treating all tribal populations as homogeneous. India has thousands of distinct tribal populations, and each has unique cultural practices, environmental conditions, and traditional health care systems. Accordingly, most research studies generalize study findings through the use of aggregated

data from various differing regions, which prevents recognition of key differences in disease prevalence, access to health care, and treatment seeking behaviors.

In addition, NCDs have introduced new challenges to establishing tribal health care systems, unlike infectious diseases that typically require once-off treatment. In general, NCDs will require constant monitoring, early detection of potential risk factors for the development of NCDs, and long-term management requirements. Although the body of literature has acknowledged the increasing burden caused by NCDs, limited attention has been given to the development of predictive health care systems to promote early intervention among tribal patients.

Critical Observations

Despite a large number of studies, current literature on the rise of NCDs amongst tribal peoples has been primarily descriptive in nature and lacks an obvious engagement with predictive healthcare models and prognostic disease models. Additionally, there is a limited exploration of traditional Indigenous healthcare knowledge's potential to alleviate some of these chronic diseases and assist tribal peoples in managing their chronic disease.

3.3 Healthcare Disparities and the Erasure of Indigenous Worldviews in Public Health Research

Healthcare disparities are one of the most common and troubling themes that appear throughout the literature on tribal health. In a number of studies, researchers have identified geographical isolation, inadequate infrastructure for healthcare, a lack of trained medical personnel, a lack of available resources and financial barriers to care as major impediments to accessing healthcare for tribal communities (Mohindra & Labonté, 2010; Mondal, 2017).

The predominant narrative within the field of public health research is that tribal peoples are populations who do not have access to adequate healthcare. While these studies have played a significant role in raising awareness about structural inequities and advocating for policy changes addressing disparities in health outcomes, they have also created another unintended consequence: they define tribal peoples primarily by what they do not have access to rather than by the knowledge and information that they already have.

While reviewing the literature on healthcare access, one will find that there is little emphasis placed on the fact that there are instances of indigenous communities utilizing indigenous knowledge for healthcare purposes. More often than not, researchers have identified the inadequacies of formal healthcare systems in supporting the provision of healthcare services in indigenous communities, but fail to recognize the existence of traditional healing practices, community health networks, and indigenous therapeutic knowledge as a source of healthcare in tribal communities (Negi & Azeez, 2022).

This unequal distribution of knowledge in health research reflects a broader hierarchy in the way that knowledge is classified and valued within the field. For example, biomedical knowledge is often considered to be scientific, objective, and authoritative; whereas, indigenous knowledge tends to be classified as traditional, local, or cultural. The way in

which knowledge is classified can also influence how research funding is allocated or how healthcare policy decisions are made.

It is important to note that indigenous knowledge does not always become marginalized as a result of explicit rejection by the biomedical community. Instead, indigenous knowledge may frequently be excluded from research simply because it was never included in the original design of the intervention. Many healthcare interventions are developed without consideration of the predominant health beliefs held by the target community or of the local community's healthcare delivery system. As a result, these interventions may not reach their intended level of effectiveness because they do not take into account the realities of the target community.

According to Mohindra and Labonté (2010), healthcare interventions aimed at indigenous populations have not been successful, in large part because of their failure to take into consideration the social and cultural context in which the intervention will be implemented. In addition to taking into consideration the social and cultural context, these authors also propose that healthcare access should be defined not only by whether the physical facilities are available, but also by whether the healthcare system is able to engage with the local community in a meaningful way.

Critical Observation:

The existing literature discusses healthcare disparities, but very few researchers have examined how indigenous healthcare knowledge can serve as a healthcare resource, instead of only acting as a cultural tradition. This has created a substantial conceptual void in tribal health research.

3.4 Artificial Intelligence and Clinical Decision Support Systems in Healthcare:

Artificial intelligence (AI) is an emerging technology that has substantially affected the way in which we conduct research and practice in the healthcare sector worldwide due to its rapid development. A wide range of applications for AI technology exists in healthcare including disease prediction, diagnostic imaging, patient monitoring, treatment planning and the overall management of healthcare resources. One such application of AI is through the use of Clinical Decision Support Systems (CDSS) which have emerged as powerful tools to help clinicians make evidence-based clinical decisions (Bompelli et al., 2021).

AI has been attractive to health care providers due to its ability to analyse vast amounts of data and identify underlying patterns that are not easily seen by the human eye. By analysing patients' medical histories, laboratory tests, behaviour patterns and demographics using machine learning algorithms, predictive analytics can be generated for the prognosis of specific diseases and the outcome of various treatment options.

Many researchers have suggested that AI holds significant promise for enhancing access to care for populations in areas where there are fewer providers with advanced medical specialties, commonly referred to as "underserved populations." Telemedicine, remote monitoring and predictive healthcare applications are technologies that may be able to help

reduce barriers to accessing health care that can limit treatment options for individuals living in rural or isolated areas (e.g., Tribal Communities).

However, the literature identifies a number of limitations in the area of AI in health care. First, there is a predominance of studies conducted in metropolitan hospitals and other technologically advanced health care facilities. As such, the datasets used to form predictive models have an inclination towards representing metropolitan populations instead of those of marginalized communities.

Second, the literature tends to focus on technical performance metrics (i.e., accuracy, precision and efficiency) while giving little attention to social and cultural dimensions of health care. Issues of trust, cultural relevance, language access, as well as community engagement are given minimal attention.

Thirdly, the concept of health knowledge as a whole is still relatively narrowly defined within many AI studies. The data used to create AI algorithms is primarily derived from biomedical facilities including electronic health records and clinical databases. There is little to no inclusion of Indigenous health experiences, traditional diagnostic practices and community-based health care systems.

As such, there are significant issues relating to algorithmic representation as well as equity. If AI systems are primarily learning from urban-based biomedical data, then it may be very difficult for them to accurately reflect the realities of health care within tribal communities. This, therefore, creates a risk of technological innovations resulting in the perpetuation of existing inequities in health care as opposed to correcting them.

Critical Observation:

Technological development of AI assisted health systems has improved dramatically according to the literature. The disconnect between technological innovations (AI) and the associated cultures of Indigenous Peoples has created a barrier between these systems and the culture of Indigenous Peoples when it comes to health care.

3.5 Epistemological Challenges - AI Technology in Health Care

At present, there is a lack of attention paid in the health care literature to the issue of the politics of knowledge production that exists when discussing AI and health care. Technical issues such as computational efficiency and predictive accuracy regarding AI have been the focus of many discussions; however, a more important issue that continues to go unanswered is: whose knowledge is represented in an AI-based system and what knowledge has been omitted?

AI-based systems are promoted as being objective, with their data being solely data (e.g., statistics) and as being non-biased; but AI-based systems are only as representative as the data on which they have been trained (in other words, the database used to build the AI-system). Indigenous experiences related to health care will not be represented in an AI-based system because they are not reflected in the health care database.

This raises concerns over issues relating to the quality of data used to build AI-systems (i.e. issues of reliability) as well as epistemological issues regarding the legitimacy of various forms of knowledge. For example, the knowledge held by tribal communities about medicinal plants, disease symptoms, environmental factors affecting health, and methods of preventing illness has been developed by these communities over generations of experience; however, such knowledge is seldom accepted as valid forms of data about health within AI research.

3.6 Integrating Tribal Medicine with AI: New Directions in Healing

Tribal medicine and artificial intelligence often seem to be worlds apart. Tribal medicine is viewed as being mostly oral, involving experiential learning, ecological knowledge and community-based traditional practices, while AI is filled with computational models, data analytics, machine learning and digital systems for making decisions. In the majority of cases in the literature, these two areas have been described as different places of knowledge with very little in common or unable to be used together. As we start to look at these areas in a more holistic way, it becomes clear that this way of thinking has important ramifications for both science and healthcare.

Historically, the development of healthcare solutions has frequently happened through the integration of various systems of knowledge, rather than by replacing one system with another. A good example of this is the development of modern pharmacology as we know it today; a large part of the history of this field of research is the work done by various tribes using plants for medicinal purposes was later verified scientifically and then adapted into an FDA approved form of medicine. This shows that traditional knowledge and scientific knowledge are not necessarily equal to each other. Rather, it suggests a better partnership between traditional indigenous health practices and contemporary technology.

3.7 AI & Tribal Medicine Combined Are New Directions in Healing:

The worlds of tribal medicine and artificial intelligence (AI) often appear to be vastly different; tribal medicine is primarily oral-based – a product of experiential learning, ecological knowledge and traditional community-based practices – while AI mostly consists of computer-based systems, typically including computational models, analytic data sources, the use of machine learning techniques and decision-making processes. With very few exceptions (supported by research findings), tribal medicine and AI have been discussed as being separate sources of knowledge; thus, we have very little information about the integration of tribal medicine with AI. Therefore, when examining these two areas holistically, it is apparent that there are significant implications to our understanding of science and healthcare as we know them.

Health care has historically developed through the integration of diverse knowledge bases instead of through the replacement of one system for another. One example of this is the creation of modern pharmaceutical science; much of the pharmacological system we have today evolved as a result of research conducted by various Native American tribes who initially utilized plants to treat illnesses, and their findings were later verified through scientific investigation and eventually developed into FDA-approved products.

Integrating healthcare has greater potential for improving health outcomes in tribal communities and other underserved areas. Tribal populations consistently experience a delay in the time it takes to receive a diagnosis of disease due to a lack of local healthcare infrastructure, limited access to diagnostic services, and a shortage of specialists. Healthcare workers may use AI-supported Clinical Decision Support Systems (CDSSs) as one tool to identify the risk of disease earlier than they would have without the assistance of these technologies. Indigenous knowledge may provide culturally appropriate information regarding health habits, adherence to treatment, environmental exposures, and community health patterns to complement health care delivery.

While the literature points to the potential benefits of new technologies for underserved populations, it also warns against technological determinism—the idea that technology will solve complex issues in society without recognizing their historical, economic, political, and cultural contexts. Inequities in healthcare experienced by tribal communities cannot be solely attributed to a lack of adequate technology; therefore, AI must be regarded as a supplement to healthcare delivery rather than a universal answer. Successful healthcare innovation must combine technological capabilities and community involvement, cultural competence, and equitable governance of health care.

Critical Observation

In general, we should see the future of tribal healthcare as a place where both traditional and tech-based medicine can coexist, working to develop innovative and integrated interdisciplinary healthcare plans using indigenous knowledge, western medicine, and the latest in technology. Rather than technological integration being the greatest challenge to achieve success, it is instead the creation of a system that accepts and values different forms of epistemological understanding that will determine how every person uses his or her own personal approach to achieving good health.

3.6 Integrating Tribal Medicine & Artificial Intelligence: New Options

The connection of tribal medicine to artificial intelligence is frequently viewed as a connection between disparate worlds. Tribes who practice medicine frequently utilize oral traditions and experiential learning methods, have an understanding of and care for the environment, and practice healing in their communities. Artificial intelligence, on the other hand, is largely characterized by the use of computer modeling, data analysis, machine learning and electronic decision-making. A search of current research literature on the two subjects will provide the reader with numerous examples of the two areas being treated as distinct and, at times, opposing ways of understanding the world around us. However, on closer examination, you can recognize that taking a binary view of the two is limiting and will often inhibit you from effectively implementing change.

The historian points out that much of today's innovation in healthcare is accomplished by combining different knowledge sources instead of replacing any one with another. Whether through pharmaceutical development or another method type, there is much to learn from the past. For instance, many of the discoveries we have made in pharmacology originated from using traditional knowledge of plants for medicinal purposes and later subjecting those

healing properties to experimental investigation and rigorous testing (Sood et al. 2019) . The history of discovery provides evidence that traditional knowledge exists separately from, or in opposition to scientific knowledge. Rather than assuming that they do, we can look for opportunities for collaboration between conventional healthcare practices of indigenous people and technology today.

The Health and Ethnomedicinal Amelioration Repository of Tribals Initiative (HEART) is an example of a growing recognition of the importance of documenting and digitizing indigenous health care knowledge (Kumar et al., 2025). Such documentation will serve more than just archival purposes, but they also provide a mechanism to include the ethnomedicinal data in larger health care systems. In theory, artificial intelligence systems can leverage these data systems to detect patterns among traditional medicines, the prevalence of specific diseases, local environmental conditions, and resulting health outcomes.

However, the integration of tribal medicine with artificial intelligence is much more than simply a technical process of converting indigenous knowledge into digital data. Indigenous healthcare knowledge is located within the context of community experiences, the cultural meaning of those experiences, and the local and ecological relationships of the community. Thus, when indigenous knowledge is abstracted from the context in which it was developed and transformed into algorithmic data, there exists the potential to simplistically extract and misrepresent the original intent and usefulness of the information. Therefore, for the integration of tribal medicine with artificial intelligence to occur, technological innovation, methodological sensitivity, and ethical responsibility are required.

The concept of diagnosis also includes various forms of diagnostics. Many traditional healers use their own methods of observation that differ significantly from the method used by practitioners in the biomedical field. These healers' methods to assess an individual's health status may include factors that span social, environmental, and spiritual aspects of the individual's life factors that are not usually captured within biomedical databases. While some researchers may view these kinds of observations as unscientific and therefore not of any help to research into health and illness, this view ignores valuable contextual information that can affect an individual's health outcomes. Future research in the areas of healthcare and illness may find it helpful to include observations made at the community level (i.e., by traditional healers) and also include those types of observations to help to validate the accuracy of biomedical indicators that are used to derive predictive healthcare models.

There are numerous potential advantages to utilizing both traditional healers and practitioners of conventional medicine in poorly-served areas of our country. For example, tribal populations often experience delays in diagnosing diseases owing to further complications, such as inadequate infrastructure for a healthcare delivery system (e.g., shortages of specialists and limited accessibility to diagnostic facilities). Also, using Clinical Decision Support Systems driven by Artificial Intelligence in the healthcare delivery system could assist healthcare workers in identifying risks for disease much earlier than currently possible. Furthermore, traditional healthcare knowledge will provide culturally-specific insights to healthcare workers relating to health-related behaviour (e.g., adherence to treatment, environmental exposure), and community health and disease patterns.

The literature warns against technological determinism, the idea that technology can solve all social problems by itself. Healthcare inequality in Native American communities has been created by historical, economical, and political factors and extended beyond healthcare technology itself – therefore, AI should be seen as an enhancing/assisting tool versus a prevailing solution. A well-developed healthcare innovation will occur through the convergence of advanced technology, active community engagement, enriched cultural perspective, and an equitable governance system.

Critical Observation

The future of Tribal Healthcare is to not be seen as a dichotomy between "traditional" and AI-based medicine but rather as a chance to create an interdisciplinary model of health systems that incorporate Indigenous Knowledge, Biomedical Science, and Innovations in Technology. The principal challenge lies not in the challenge of integrating technology but rather, changing how knowledge about health and disease is created and recognized.

4. Research Gap

The review of the existing research literature has identified a number of conceptual, methodological and empirical gaps that need further investigation in relation to tribal medicine and the use of artificial intelligence in healthcare.

In the first area, tribal medicine has been extensively documented by way of ethnobotanical inventories of the plants utilized as medicine, as well as the rituals or practices employed by tribal healers (Sood et al., 2019; Mondal & Bhattacharya, 2023). While the recording of this information is critically important in order to preserve the knowledge of the indigenous people, published literature does not include any consideration of how tribal medicine aids in the forecasting of disease occurrences, predicting risks, or managing long-term healthcare.

Next, most of the published literature on non-communicable diseases among indigenous populations has, in recent years, become more prevalent. However, most research has focused on prevalence, risk factors, and access to healthcare services through an examination of health disparities (Kaur et al., 2022; Sathiyarayanan et al., 2019). Therefore, there is an opportunity to study how traditional forms of healthcare by indigenous people contribute to features such as early detection, prevention of diseases, and support the making of predictions about the course of a disease.

Lastly, currently available AI-based literature on healthcare tends to focus on biomedicine and urban clientele. The majority of current predictive algorithms have been developed from hospital databases, electronic medical records, and other forms of institutional health information (Bompelli et al., 2021). This leads to the absence of tribal experiences in addition to indigenous knowledge to be considered in the processes of developing algorithms and innovating in healthcare.

Fourth, there is a significant lack of interdisciplinary research connecting tribal medicine, disease prognosis, and Artificial Intelligence within a single analytical framework. Most studies treat these subjects as separate areas of inquiry, resulting in fragmented knowledge production and limited opportunities for integrated healthcare solutions.

Fifth, very little research addresses the epistemological implications of incorporating indigenous healthcare knowledge into AI-based Clinical Decision Support Systems. Questions regarding representation, knowledge validation, algorithmic inclusion, and cultural sensitivity remain insufficiently explored within existing scholarship.

Finally, there is a noticeable absence of region-specific studies focusing on tribal populations in South Indian regions such as Rayalaseema. While tribal healthcare research has been conducted in various parts of India, the intersection of indigenous medicine, chronic disease prognosis, and AI-driven healthcare remains underexplored in the Rayalaseema context.

5. Future Research Directions

Based on the conclusions drawn from this review, a number of important future research areas can be identified.

First, future research should go beyond the mere description of indigenous medicinal practices in favor of studying the contribution of indigenous healthcare knowledge to disease prevention and healthcare risk assessment. Such a step would allow for the transformation of tribal medicine into a proactive actor in healthcare innovations.

Another area of focus for future research should be the development of culture-sensitive Clinical Decision Support Systems which would incorporate both indigenous healthcare practices and biomedically relevant factors. Instead of basing their decision-support capabilities only on institutional healthcare data, future AI models should take advantage of various other pieces of information such as environmental factors and health practices of particular tribal groups.

An interdisciplinary effort will be needed in order to make such research possible. It should involve public health specialists, sociologists, anthropologists, artificial intelligence scientists, healthcare professionals, and representatives of the indigenous populations themselves.

Finally, the issue of ethical challenges associated with AI applications in the indigenous context needs further elaboration. Ownership issues and the necessity of obtaining informed consent from members of tribal societies should become major focus for future studies.

5. Future Research Directions

Further directions for research can be found in developing regional healthcare frameworks as well. Due to the vast diversity of healthcare issues among various tribal communities, the study of specific regions such as Rayalaseema would yield better results than national studies.

The goal of future research efforts, however, should be to create an integrated healthcare model that brings together traditional approaches with modern healthcare technologies.

6. Conclusions

As shown in the review of literature, tribal medicine, disease prognosis, and Artificial Intelligence can be considered three separate but significant aspects of healthcare research today. Although there has been a considerable amount of literature devoted to tribal medicine, it mainly emphasizes the value of documenting indigenous knowledge for the future generations without making any effort to explore how it can be used for predictive purposes.

At the same time, although the problem of chronic diseases among tribal peoples has been successfully investigated, indigenous knowledge in healthcare has remained unexplored as an alternative source of preventive healthcare information.

On the other hand, it should be stressed that Artificial Intelligence has become one of the most relevant areas of healthcare today. The use of AI-driven CDSS makes it possible to predict diseases and manage patients' conditions. Nonetheless, all existing health informatics frameworks utilize data based on biomedical knowledge and institutions while indigenous people's health information and practices are excluded from this process. It is possible to speak about the exclusion of indigenous knowledge and experiences in the framework of healthcare development at large.

However, according to the critical literature analysis, the development of the future healthcare system cannot occur only due to technology innovations but also by addressing problems associated with cultural relevancy, social justice, knowledge representation, and community participation. Instead of regarding tribal medicine as a traditional health care practice that exists on the periphery of modern society, it should be perceived as evolving wisdom that is formed by interactions between people, diseases, and local ecosystems over many generations.

Another perspective discussed in the literature analysis is the possibility of integration between indigenous health care knowledge and an artificially intelligent-based clinical decision support system. Such an approach has huge potential to help achieve better disease prognosis, improve the accessibility of health care services, and provide culturally sensitive health care for marginalized tribal communities. At the same time, this goal can be reached not only through the creation of new technologies but also by recognizing the contribution of indigenous wisdom to healthcare management.

Finally, the review suggests that the incorporation of indigenous knowledge of healthcare and AI technologies into CDSS presents an interesting path for future healthcare progress. In doing so, researchers may help enhance the ability to make more accurate predictions about diseases, increase access to health care services, and provide culturally competent care for underprivileged indigenous communities. Yet, to be able to incorporate different sources of knowledge into a single health care system, one needs to recognize the value of indigenous knowledge itself.

In conclusion, the debate over which medicine is better tribal or modern and whether one has to give up AI or traditional practices is irrelevant here. What matters instead is the creation of health care models that could take into consideration both types of knowledge as well as resolve existing health care disparities.

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