TCM-Based Integrative Medicine for Sjögren's Syndrome: Bridging Traditional Wisdom and Modern Healthcare

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Abstract

Objective   This review systematically examines the potential of Traditional Chinese Medicine (TCM) in treating Sjögren's syndrome (SS), focusing on its role in immunomodulation, inflammation reduction, and symptom relief. It also explores how TCM's personalized strategies align with modern precision medicine concepts. **Methods**   We analyzed literature from PubMed, Web of Science, and Chinese medical databases (2017–2025), using keywords such as "Sjögren's syndrome and Traditional Chinese Medicine," "acupuncture and autoimmune diseases," and related terms. Evidence was synthesized from clinical trials, observational studies, and mechanistic research. **Results**   TCM demonstrates significant potential in SS management through immunoregulatory and anti-inflammatory mechanisms. Herbal formulations modulate innate and adaptive immune responses, while acupuncture alleviates symptoms via neuromodulation and anti-inflammatory pathways. Modern technologies like AI and multi-omics enhance TCM's precision, and integration with Western medicine offers comprehensive treatment strategies. **Conclusion**   Integrating TCM into SS care provides a promising complementary approach, leveraging personalized treatments that address both symptoms and pathophysiology. However, standardization and rigorous validation are still needed. Future efforts should focus on developing standardized protocols and conducting high-quality clinical trials to establish evidence-based integrative guidelines.

Keywords: Sjögren's syndrome; Traditional Chinese Medicine; Chinese herbal medicine; Acupuncture; Immunomodulation; Integrative medicine.

1. Introduction

1.1 Overview of Traditional Chinese Medicine

Traditional Chinese Medicine (TCM), a medical system with a long history, is centered on holistic concepts and syndrome differentiation treatment, emphasizing the balance and harmony of the body's internal environment. Its theoretical foundation includes Yin-Yang, the Five Elements, Qi, blood, body fluids, as well as the Zang-Fu organs and meridians, forming a unique system for diagnosis and treatment. As two pillars of TCM, Chinese herbal

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medicine and acupuncture have shown remarkable effectiveness in the treatment of various chronic diseases, particularly in the management of autoimmune diseases. In recent years, with the ongoing exploration of the scientific connotations of TCM and the improvement of research methods, TCM's treatment concepts and methods have gradually gained recognition from modern medicine and now occupy a significant place in the comprehensive treatment of various diseases.

TCM emphasizes individualization and holistic regulation, aligning with the concept of modern precision medicine. Syndrome differentiation treatment, as the core method of TCM, customizes treatment plans based on the patient's overall condition and symptom characteristics, helping to improve the specificity and effectiveness of treatment. With the development of computational technologies, advanced methods, including artificial intelligence, have been applied to TCM diagnosis and prescription generation, further enhancing the precision and reliability of TCM treatments.

The historical evolution of TCM highlights its adaptability and resilience over time, as it continues to integrate new knowledge and practices while maintaining its fundamental principles. This adaptability is reflected in TCM's response to contemporary health challenges, such as the increasing prevalence of autoimmune and chronic diseases, which require multifaceted treatment approaches. The integration of TCM with modern medical practices not only enhances treatment protocols but also fosters a more comprehensive understanding of patient care. Furthermore, with the continuous in-depth study of the efficacy of TCM therapies, there is a growing interest in scientifically validating these methods and incorporating them into the framework of conventional healthcare. This integration is crucial in bridging the gap between traditional and modern medical paradigms and promoting more comprehensive approaches to patient treatment and care. In summary, the exploration of TCM principles and practices provides valuable insights into its potential applications in treating various health issues, including autoimmune diseases like Sjögren's syndrome. The ongoing dialogue between traditional and modern medicine can lead to innovative treatment strategies, improving patient outcomes and quality of life. As the demand for integrated treatment plans in healthcare continues to grow, the historical significance and contemporary relevance of TCM will continue to shape its unique role in modern medicine and provide a solid foundation for future research innovations and clinical applications.

1.2 The Significance of Traditional Chinese Medicine in the Treatment of Sjögren's Syndrome

Sjögren's syndrome is a chronic autoimmune disease affecting millions of people, characterized by systemic imbalances in the body. In addition to common dry eye symptoms, it can also lead to severe complications such as extraocular manifestations that threaten vision. Approximately four million people in the United States are affected by this disease, but underdiagnosis often results in high morbidity and mortality rates, highlighting the importance of targeted treatment methods [1,2].

In Traditional Chinese Medicine (TCM), Sjögren's syndrome is classified under "dryness syndrome" and "deficiency of vital energy" categories, with its pathogenesis primarily involving Yin deficiency, Qi and blood deficiency, and insufficient body fluids. TCM treatment emphasizes nourishing Yin and generating body fluids, replenishing Qi and blood, and regulating the balance of Yin and Yang to fundamentally adjust the patient's internal environment and improve glandular function. The holistic approach and syndrome differentiation treatment in TCM diagnose and treat diseases by understanding the unique symptom characteristics and potential imbalances of each patient, providing personalized treatment strategies, which aligns closely with the concept of modern precision medicine.

TCM practices involve multifaceted treatment methods such as Chinese herbal medicine and acupuncture [3]. Acupuncture, one of the oldest medical

techniques in TCM, alleviates symptoms and enhances the body's natural healing process by stimulating specific acupuncture points. Although TCM practice requires practitioners to have extensive knowledge of Chinese herbal medicine classifications and applications, it offers unique diagnostic tools (such as tongue diagnosis) that provide valuable insights into the patient's health status, complementing modern diagnostic methods [4-6].

Recent studies have highlighted the potential of combining ancient therapies with modern biomedical approaches. Integrating Traditional Chinese Medicine and Western medicine can improve clinical outcomes and provide more comprehensive treatment options for patients. With advances in data-driven methodologies and natural language processing, our understanding of the effectiveness and safety of TCM in contemporary medical environments continues to deepen.

The significance of TCM in the treatment of Sjögren's syndrome lies in its holistic approach, which combines ancient therapeutic methods with modern biomedical strategies. It offers tailored interventions to address the unique systemic imbalances inherent in autoimmune diseases, improving patients' overall health and quality of life. In the context of modern precision medicine and personalized treatment, TCM's holistic concepts and individualized treatment strategies are particularly important, providing a more comprehensive and personalized treatment plan for patients with Sjögren's syndrome. See Figure 1.
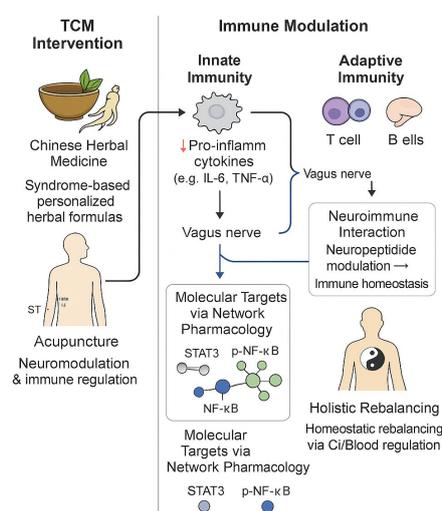

Figure 1. Integrative Mechanisms of TCM in Sjogren's Syndrome Management

2. Background and Core Concepts

2.1 Overview of Sjögren's Syndrome

Sjögren's syndrome is a chronic autoimmune disease characterized by lymphocytic infiltration and destruction of exocrine glands, primarily affecting the salivary and lacrimal glands, leading to dry mouth and dry eyes. Systemic manifestations, such as fatigue, joint pain, and vasculitis, further complicate its clinical presentation, requiring a multifaceted approach to management. The disease's pathogenesis involves genetic susceptibility, environmental factors, and immune dysregulation, resulting in the production of autoantibodies and activation of autoreactive T and B cells. Clinical datasets, including whole slide images (WSIs) of patients, reveal a variety of immune biomarkers, reflecting the disease's heterogeneity, which poses challenges for diagnosis and treatment [7]. Current treatment strategies focus on symptom relief and immunosuppressive therapy, but they often fail to adequately address systemic symptoms or prevent disease progression. This limitation has sparked interest in alternative and integrative therapies, such as Traditional Chinese Medicine aimed at improving clinical outcomes and enhancing patients' quality of life. The higher prevalence of Sjögren's syndrome in women further underscores the need for innovative treatment strategies and a deeper understanding of

its pathogenesis. As research advances, immunological insights are crucial for developing targeted therapies tailored to the specific needs of Sjögren's syndrome patients, highlighting the limitations of conventional treatment methods.

The significance of Sjögren's syndrome extends beyond its clinical symptoms and is intertwined with other autoimmune diseases, increasing the complexity of diagnosis and treatment. Its interaction with diseases such as rheumatoid arthritis and systemic lupus erythematosus demands a comprehensive understanding of autoimmune disorders. This understanding contributes to improving patient care and advancing the broader field of autoimmune research, emphasizing the importance of interdisciplinary approaches in addressing the complexity of autoimmune diseases. These methods pave the way for integrating traditional medicine with modern medical treatment models.

2.2 Definition and Key Terminology of Traditional Chinese Medicine

Traditional Chinese Medicine is a comprehensive medical system with thousands of years of history, combining clinical experience and therapeutic practices such as acupuncture, herbal medicine, and dietary therapy. TCM emphasizes the balance of body, mind, and environment, advocating for a personalized and holistic approach to health. As TCM methods gain increasing attention within the framework of Western medicine and gradually integrate into it, understanding the fundamental principles and clinical applications of TCM has become more important. This is crucial for promoting effective communication between TCM practitioners and traditional healthcare professionals [3,8-11]. The core principles of TCM include Yin-Yang balance, the Five Elements theory, and the regulation of Qi, blood, and body fluids, which guide diagnostic and treatment strategies. These principles emphasize maintaining harmony within the body and between the individual and the surrounding environment, offering a dynamic and integrated view of health. Syndrome Differentiation and Treatment is the corner-stone of TCM, classifying diseases based on patterns of symptoms, signs, and underlying mechanisms. This approach requires comprehensive reasoning to identify syndromes and create personalized treatment strategies. Unlike the reductionist paradigm of Western medicine, syndrome differentiation in TCM considers the dynamic interactions between body systems and external factors, providing a personalized intervention framework. The complexity of syndrome differentiation is further compounded by the use of free-text clinical records in TCM, requiring advanced analytical tools to uncover hidden symptom patterns and improve diagnostic accuracy [12]. The increasing relevance of modern computational methods helps to better understand patient clinical presentations and treatment responses.

Chinese Herbal Medicine plays a central role in TCM, addressing specific syndromes through the classification of herbs. The challenge in herbal classification lies in the need for extensive knowledge to understand the relationship between symptoms and prescriptions. Additionally, the chemical complexity of herbal formulas makes understanding their therapeutic mechanisms difficult [13]. Through processing techniques such as reducing toxic components, enhancing solubility, and altering structural properties, the safety and efficacy of herbs can be ensured, highlighting the importance of excipients in optimizing treatment outcomes [14]. Research into the pharmacological properties of herbal ingredients is crucial for validating TCM practices, bridging traditional knowledge with modern scientific inquiry.

Holistic Treatment in TCM integrates multiple therapeutic methods—herbal medicine, acupuncture, dietary therapy, and lifestyle adjustments—aimed at addressing symptoms and treating diseases at their root. This approach aligns with the body's natural healing processes and emphasizes restoring balance and harmony. TCM's historical efficacy in responding to epidemics, with over 300 recorded cases, proves its adaptability and relevance in ad-

dressing complex health challenges [15]. The potential of TCM in combating COVID-19 further demonstrates its therapeutic potential in global health crises and underscores the importance of understanding its principles for effective application [16]. The adaptability of TCM in contemporary health challenges highlights its enduring significance, necessitating ongoing research to assess its efficacy and safety in various clinical settings.

Despite its rich history, TCM faces challenges in integrating with modern medicine due to theoretical differences and a lack of specialized literature. Advances in artificial intelligence (AI) and computational methods, particularly in natural language processing and prompt engineering, are enhancing AI systems' capabilities in TCM. The TCM-SD benchmark, covering over 54,000 real-world clinical records, has improved the accuracy of syndrome differentiation, while the TCM-prompt framework fine-tunes large language models to address TCM-specific tasks. Innovations like Tree-Structured Reflexive Retrieval (TOSRR) have improved the accuracy of TCM question-and-answer systems, indicating that these advancements effectively bridge existing gaps [12,17,18]. Network pharmacology platforms and syndrome-aware frameworks have enhanced prescription generation, optimized treatment strategies, and modernized TCM practice. Integrating these technologies is expected to transform traditional practices into evidence-based interventions validated through rigorous scientific methods.

TCM embodies a dynamic and integrated approach to healthcare, emphasizing personalized treatment through syndrome differentiation and holistic care. By leveraging modern technologies and evidence-based research methodologies, TCM continues to evolve and remain relevant in contemporary medical practice. This progress facilitates the integration of TCM with Western medicine, offering collaborative solutions for complex health conditions. The therapeutic methods employed in TCM─such as herbal medicine, acupuncture, and TuiNa (therapeutic massage)─are rooted in a systematic health framework that prioritizes safety and efficacy. Advances in database management enhance the handling of clinical and research data, which is crucial for improving decision-making and fostering effective communication between TCM practitioners and traditional healthcare professionals. This integration is supported by ongoing clinical trials and research, revealing the mechanisms of TCM and enhancing the understanding of its therapeutic benefits when combined with Western medical paradigms [3,9].

2.3 Immunoregulation in Autoimmune Diseases

Immunoregulation plays a central role in understanding and treating autoimmune diseases such as Sjögren's syndrome. The balance between immune activation and suppression mechanisms not only ensures effective defense against pathogens but also prevents tissue damage caused by excessive immune responses. Acupuncture and TCM therapies, through precise stimulation of specific acupuncture points, effectively regulate both the innate and adaptive immune systems, as well as their associated neuroanatomical pathways, thereby maintaining the body's internal homeostasis and balance [19-22]. In autoimmune disease states, this fine balance is disrupted, triggering the immune system to abnormally attack the body's own tissues, particularly causing significant damage to the exocrine glands in Sjögren's syndrome patients.

Immunoregulation demonstrates unique therapeutic value in the field of autoimmune diseases. TCM acupuncture and herbal therapies, with their remarkable immunoregulatory effects, help to restore the damaged immune balance. For example, acupuncture, by stimulating specific acupuncture points, precisely regulates immune cell functions and cytokine secretion profiles [20]. A deeper exploration of these regulatory mechanisms provides a solid scientific foundation for the seamless integration of TCM theories with modern treatment regimens for autoimmune diseases. The NP-TCM target model, which integrates chemical and biological data to locate the targets of Chinese medicine, successfully

resolves the complexities of TCM and its interactions with the human body [13]. This model reveals the unique potential of Chinese medicine in multi-dimensional immune regulatory pathways, offering systematic therapeutic strategies for autoimmune diseases. The application of this integrated model aids researchers in comprehensively understanding the multifactorial nature of immune regulation and in developing precision-targeted therapies that align with the holistic philosophy of TCM. The Meridian Conduction Theory Model holds a central position in explaining the immunoregulatory mechanisms of TCM. Meridian fluctuations, as the physical manifestation of Qi flowing through the meridian system, play a decisive role in maintaining immune system homeostasis and blocking disease progression [6]. Modern scientific exploration of these traditional theoretical concepts not only deepens our understanding of TCM's theoretical system but also highlights the innovative therapeutic strategies and development directions that integrate traditional medical wisdom with modern scientific technology.

3. Chinese Herbal Medicine in Sjögren's Syndrome

3.1 Chinese Herbal Medicine

Chinese herbal medicine is a key component of Traditional Chinese Medicine, playing an important role in the management of Sjögren's syndrome by addressing its underlying pathological mechanisms. Treatment is guided by syndrome differentiation and treatment, which is crucial for accurate diagnosis and effective therapy [11]. This involves identifying specific symptom phenotypes and tailoring herbal prescriptions accordingly, thereby enhancing the precision of TCM interventions. Syndrome differentiation emphasizes each patient's unique condition, aligning with TCM's holistic approach to restore balance in the body. The diversity of Chinese herbs presents both opportunities and challenges. The unique therapeutic effects of each herb require a deep understanding of their pharmacological actions and interactions. Preparation methods, such as stir-frying or steaming, are crucial for optimizing therapeutic effects and ensuring safety [23]. These

processes can enhance efficacy while reducing toxicity. The complexity of herbal combinations requires careful formulation, as the synergistic effects of multiple herbs significantly impact treatment outcomes. Research into Chinese herbs involves exploring molecular elements, assessing bioactivity and toxicity, and understanding the combined effects of herbal ingredients within biological networks. This comprehensive approach is vital for identifying effective herb-symptom pairings, particularly in the treatment of Sjögren's syndrome. Clinical case databases established through web crawlers and advanced retrieval technologies help improve the accuracy of TCM diagnosis and the effectiveness of herbal prescriptions [11]. These advances have promoted targeted treatment methods and contributed to the growing body of evidence supporting the efficacy of Chinese herbal medicine. In treating Sjögren's syndrome, specific herbs are chosen for their ability to regulate immune function and alleviate symptoms such as dry mouth and dry eyes. The integration of modern scientific methods with traditional practices drives development in this field, contributing to the formation of effective drugs and treatment strategies [23]. Ongoing research and innovation in Chinese herbal medicine expand its role in integrative medicine, offering promising pathways for improving clinical outcomes in autoimmune diseases like Sjögren's syndrome. This evolving field emphasizes the need for continued exploration and validation of herbal therapies to ensure their effective integration into standard care practices.

3.2 Mechanisms and Efficacy

The mechanisms and clinical efficacy of Chinese herbal medicine in treating Sjögren's syndrome are rooted in the complex interactions between herbal ingredients and biological systems. The NP-TCM target model, by predicting the binding targets of herbal components, reveals the relationship between herbs and direct or indirect targets within the TCM action pathways [13]. This predictive ability is crucial for understanding how specific herbs modulate immune responses and alleviate the symptoms

of Sjögren's syndrome. By elucidating these interactions, researchers can formulate effective herbal prescriptions for specific symptom profiles.

The framework proposed by Gan et al. emphasizes the relationships between herbs and symptoms within the human protein interaction network, providing a comprehensive map of herb interactions that influence disease pathways [22]. This network medicine approach highlights the importance of considering the overall interactions within the body, consistent with TCM's integrative philosophy. Understanding these relationships aids in the selection of appropriate herbal treatments and the development of compound therapies that harness the synergistic effects of multiple herbs. Advanced modeling techniques, such as Random Forest Interaction Trees, promote the exploration of therapeutic effects by capturing complex herb-symptom interactions [24]. This advancement facilitates a deeper understanding of how to optimize the clinical efficacy of Chinese herbal medicine, particularly in autoimmune diseases such as Sjögren's syndrome. Modeling these interactions provides valuable insights, guiding clinicians in the development of effective treatment strategies.

By integrating modern computational models like RoKEPG, which refines Chinese medicine prescription generation by incorporating the nonlinear relationships between herbs and symptoms [25], these methods leverage machine learning to enhance prescription accuracy. This ensures that herbal formulations can be personalized based on the specific symptomatic manifestations of patients. Advanced methodologies make personalized TCM medicine increasingly feasible, tailoring treatments more closely to individual patient needs. Furthermore, herb recommendation systems based on syndrome perception, which deduce syndrome representations from symptom sets, achieve precise herb scoring and selection [26]. This precision is crucial for addressing the diverse manifestations of Sjögren's syndrome, improving treatment outcomes. These systems enhance the accuracy of herb selection, promoting the systematization of TCM's holistic approach to treatment and bridging traditional practices with modern scientific methods. Wang et al.'s framework categorizes TCM contributions based on clinical efficacy and molecular mechanisms, providing a structured method for evaluating the therapeutic potential of herb-symptom relationships in managing Sjögren's syndrome [23]. This comprehensive understanding underscores the potential of Chinese herbal medicine as an integrative medical strategy in managing autoimmune diseases, paving the way for further research and clinical application.

Table 1: Comparison of various Traditional Chinese Medicine methods in addressing herbsymptom relationships for Sjögren's Syndrome.

Method Name	Symptom Differentiation	Predictive Modeling	Systematic Integration
Tcm-CAS [11]	Syndrome Differentiation Reasoning	-	Rag And Advanced
NPTCMtarget [23]	-	Predict Binding Targets	Integrating Chemical Biological
RFIT [24]	-	Forecast Treatment Effects	-
SMGCN [26]	Specific Symptom Set	Predict Herb Scores	Traditional Practices Combination

3.3 Herb-Symptom Relationships

In Traditional Chinese Medicine, the relationship between specific herbs and the symptoms of Sjögren's syndrome is crucial, as the efficacy of herbal interventions is closely tied to their ability to address specific symptoms. This relationship is guided by syndrome differentiation and treatment, facilitating the identification of effective herb-

symptom pairings to address specific clinical manifestations [11]. Accurate pairing involves understanding the pharmacological properties of each herb and its interactions within the biological systems affected by Sjögren's syndrome. This meticulous approach ensures personalized treatment for each patient's unique condition. Table 1 presents a comparative analysis of herb-symptom relationships in Sjögren's syndrome within the context of TCM, emphasizing their roles in syndrome differentiation, predictive modeling, and system integration. The NP-TCM target model, by predicting the binding targets of herbal components, clarifies these relationships, enhancing the understanding of how specific herbs regulate immune responses and alleviate symptoms such as dry mouth and dry eyes [13]. This predictive ability optimizes the clinical use of herbs, ensuring that treatments are tailored to meet the unique needs of Sjögren's syndrome patients. Mapping these interactions makes herbal prescription decisions more informed, ultimately improving treatment outcomes.

Modern modeling techniques, such as RFIT (Random Forest Interaction Trees), enhance the exploration of these interactions by capturing the complex dynamics between herbs and symptoms [24]. This approach aligns with the network medicine framework proposed by Gan et al., emphasizing the holistic interactions between various parts of the body and their impact on disease pathways [22]. Understanding these dynamics is crucial for developing effective treatment strategies, especially in dealing with the multifaceted nature of autoimmune diseases. Syndrome-perception-based herb recommendation systems, which derive syndrome representations from symptom sets, optimize the precision of herb selection [26]. This precision is particularly important for addressing the diverse manifestations of Sjögren's syndrome, improving treatment outcomes. These systems enhance the accuracy of herb selection and promote the systematization of TCM methods, bridging traditional practices with modern scientific approaches. The framework developed by Wang et al. classifies the contributions of TCM based on clinical efficacy and molecular mechanisms, providing a structured method to assess the therapeutic potential of herb-symptom relationships in managing Sjögren's syndrome [23]. This comprehensive understanding highlights the potential of Chinese herbal medicine as an integrative strategy in the management of autoimmune diseases, further advancing research in this field.

3.4 Formula and Prescription Development

The development of herbal formulas in Traditional Chinese Medicine combines traditional knowledge with modern scientific methods, aiming to optimize therapeutic outcomes. The Chinmedomics system systematically classifies TCM syndromes and herbal formulas, identifying effective components targeting specific metabolic pathways [27]. This approach enhances the precision of TCM prescriptions, ensuring they are tailored to the unique pathophysiological characteristics of each patient. Analyzing these relationships allows clinicians to develop effective personalized treatment plans.

Recent advances in computational modeling have optimized prescription development. The Prescription-Level Language Modeling (PLLM) method treats each prescription as a holistic entity, improving its efficacy by learning distributed representations of Chinese herbs [28]. This method helps to understand the complexity of herb interactions within a prescription, improving the accuracy and effectiveness of treatment strategies. By focusing on the holistic nature of herbal combinations, practitioners can leverage the synergistic effects of multiple herbs. Through innovative sequence-to-sequence frameworks, the process of generating TCM prescriptions based on symptom descriptions has been enhanced [29]. This method translates syndromes into precise herbal formulations, streamlining the prescription generation process and improving clinical outcomes. In clinical settings, timely and effective treatment is crucial for patient health, and efficiently generating personalized prescriptions helps provide better care. The RoKEPG model, by pretraining RoBERTa on TCM corpora and fine-tuning with attention masking, enhances the precision of

TCM prescription generation [25]. This method utilizes machine learning techniques to improve the quality of prescription development, ensuring it is adjusted based on comprehensive TCM theory and practice. The application of these advanced models improves prescription quality and strengthens confidence in the efficacy of TCM treatments. The SMGCN model, by using multilayer neural networks to learn embeddings from multiple graphs, enhances the accuracy of herb recommendations [26]. This method ensures that prescriptions meet the specific needs of patients, significantly enhancing the application potential of personalized medicine in TCM and paving the way for more effective treatment strategies. Moreover, the THC luster method, compared to traditional methods, improves the accuracy of herb classification, providing reliable tools for optimizing TCM prescriptions [5]. Accurate herb classification is crucial in formula development, ensuring that prescriptions are both effective and safe. Refined herb classification allows

practitioners to better adjust treatments based on the needs of Sjögren's syndrome patients.

The integration of these methods highlights the synergistic effect of TCM principles and modern scientific technologies, improving the precision and efficacy of herbal formulas and prescriptions. This integration drives the development of evidence-based practices and addresses challenges in quality control and efficacy evaluation of herbal treatments. By utilizing advanced research strategies, such as metabolomics and machine learning models, a bridge is created between ancient practices and modern biomedical standards, improving clinical outcomes and facilitating the acceptance of TCM in global healthcare systems [3,25,27,29,30]. This integration is crucial for advancing the role of TCM in managing complex diseases such as Sjögren's syndrome, where personalized and targeted treatment strategies are key to achieving therapeutic success.

Table 2: Key benchmarks employed in the evaluation of Traditional Chinese Medicine and related domains.

Benchmark	Size	Domain	Task Format	Metric
TCM-QA [10]	801	Traditional Chinese Medicine	Question Answering	Precision, Responsiveness
ImmunoHistoBench [7]	1000000	Autoimmunity	Detection	Accuracy, AUC
QiboBenchmark [31]	2000000	Traditional Chinese Medicine	Nlp Tasks	Rouge-L, Accuracy
TCMBench [32]	5473	Traditional Chinese Medicine	Question Answering	TCMScore, Accuracy
TCMD [33]	3451	Traditional Chinese Medicine	Multiple-Choice Question Answering	Accuracy

3.5 Challenges in the Evaluation of Chinese Herbal Medicine

The evaluation of Chinese herbal medicine (CHM) faces numerous challenges, which hinder its full integration into modern healthcare systems. A significant barrier is the lack of clinical data, which makes it difficult to verify the efficacy and safety of TCM through modern scientific methods [34]. Converting TCM terminology into a structured format suitable for modern artificial intelligence technolo-

gies exacerbates this issue, requiring a comprehensive ontology that accurately captures the subtle differences in TCM concepts. This complexity demands standardization of TCM practices and better accessibility of data so that researchers and practitioners can effectively utilize this information. The limitations of current databases, such as the inclusion of only 88 herbs, highlight the challenge of not covering all Chinese herbal plants [35]. This limitation restricts the scope of research and makes it dif-

ficult to identify herbs with less obvious characteristics, which are essential for a comprehensive understanding of herbal medicine. Expanding databases to include a broader range of herbs is critical for advancing research and ensuring that practitioners have access to comprehensive clinical decision-making information.

Table 2 provides a detailed overview of the representative benchmarks used in TCM and related fields, showcasing the various methods and metrics applied in this domain. The PLLM method demonstrates an innovative approach to overcoming challenges by modeling the entire prescription context. However, traditional methods often overlook the complex relationships captured by PLLM, affecting the accuracy of herb selection [28]. Basic seq2seq models suffer from repetition issues, generating the same herbs multiple times, which impacts prescription recall and effectiveness [29]. Addressing these methodological flaws is crucial for improving the reliability of herb recommendations. The quality of input data plays a key role in the performance of advanced methodologies, such as syndrome-based herb recommendation systems. Noisy or incomplete prescriptions reduce the effectiveness of these systems, highlighting the need for high-quality datasets [26]. Similarly, algorithms like THC luster depend on the completeness of input data, and deficiencies or incompleteness in datasets can impact their performance [5]. Ensuring data accuracy and completeness is crucial for the successful implementation of advanced models.

Effectively addressing the challenges in herbal medicine requires a comprehensive strategy that focuses on improving data quality through meticulous data cleaning and structuring, developing robust ontologies that include key attributes for effective classification, and refining computational models — leveraging deep learning techniques and prompt engineering frameworks — to accurately capture the complex relationships and dynamics inherent in TCM practices. This approach will enhance the precision of herb recommendations and side-effect prediction, advancing the digitization and modernization of TCM [11,18,28,34]. These advancements are essential for establishing scientifically validated frameworks to assess the efficacy and safety of TCM in treating diseases like Sjögren's syndrome.

4. Acupuncture and Immune Regulation

To understand the role of acupuncture in immune regulation, it is essential to study its basic principles within Traditional Chinese Medicine. This exploration reveals the theoretical foundation of acupuncture and lays the groundwork for its practical applications and mechanisms. The following section will discuss acupuncture practices in TCM, emphasizing its historical significance and current therapeutic relevance.

4.1 Acupuncture in Traditional Chinese Medicine

Acupuncture is a key therapy in TCM, involving the insertion of fine needles into specific acupuncture points to relieve pain and treat various health issues [36]. Rooted in TCM theory, acupuncture is believed to regulate the "Qi" (vital energy) in the meridians, restoring balance to the body and promoting health [37]. While the anatomical and functional basis of acupuncture points and meridians is still under investigation, the need for scientific validation is increasingly recognized [38]. The therapeutic effects of acupuncture, particularly its anti-inflammatory properties, are supported by research on acupuncture points like ST36, which has proven clinical relevance in managing inflammatory diseases [39]. Modern technologies such as near-infrared spectroscopy have deepened our understanding of acupuncture by monitoring hemodynamic responses to acupuncture stimulation [40]. Technological advances have enhanced acupuncture practice by introducing visualization tools and digital technologies to improve the precision and accessibility of acupuncture. Digital systems provide real-time facial alignment and hair segmentation features, offering a visual overlay of facial acupuncture points for accurate positioning [41]. The HBot 3D model aids in understanding acupuncture applications [42]. Exploring the anatomical distribution of acupuncture points has revealed their correlation with muscle structures, providing

insights into the physiological effects of acupuncture[6]. Laser acupuncture provides a needle-free alternative, particularly beneficial for patients with needle phobia, thereby expanding the applicability of acupuncture[21]. Acupuncture training has historically faced challenges due to reliance on 2D resources, which fail to fully represent the complexity of anatomy[43]. Innovative training methods and ongoing research are essential for optimizing acupuncture practices and strengthening their integration with modern healthcare. Observational studies and meta-analyses have demonstrated the benefits of acupuncture compared to standard care, emphasizing its importance in both traditional and modern medical paradigms[44].

4.2 Immune Regulation Mechanisms through Acupuncture

The impact of acupuncture on immune regulation involves complex neurophysiological, biochemical, and mechanical interactions. Acupuncture is believed to regulate immune responses by affecting the mesenteric pathways that connect acupuncture points with internal organs[37]. Specific signaling pathways, such as those involving the vagus nerve, contribute to the anti-inflammatory response at points like ST36[39]. Technologies like NIRS play a key role in analyzing brain hemodynamics under acupuncture, helping to deepen our understanding of acupuncture's neurophysiological effects on immune regulation[40]. AcuVR combines real-world anatomical structures with 3D visualization of acupuncture points, creating an interactive environment for learning and application[43]. Laser acupuncture has been classified and studied based on its physiological effects and mechanisms, expanding its clinical applications in immune regulation[21]. Systems like Face Atlas AR, which utilize augmented reality technology, precisely locate facial acupuncture points, improving treatment accuracy and efficacy[41]. Theoretical models, such as those proposed by Luo et al., suggest that acupuncture's effects can be understood as a mechanical wave phenomenon that integrates neurophysiological and biochemical processes, influencing immune function[6]. This view aligns with the broader understanding that acupuncture points have specific physiological effects, which require scientific validation[38].

Despite the integration of TCM methods with artificial intelligence offering new ways to predict side effects and influence immune regulation, challenges remain in determining whether acupuncture outperforms placebo controls in randomized controlled trials (RCTs)[44]. Continued exploration of acupuncture's immune regulation mechanisms will further highlight its potential as part of an integrative strategy in managing autoimmune diseases.
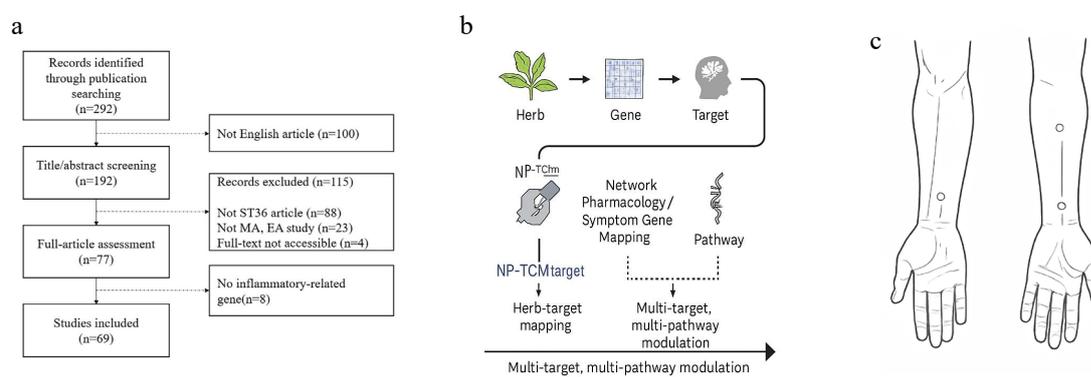

Figure 2: Examples of Mechanisms of Immune Regulation through Acupuncture

(a) Flowchart of Study Selection Process39，(b) Predicting Novel NetworkProximal Herbs for TCM Herbs and Symptoms22，(c) Comparison of Hand Positions38

As shown in Figure 2, the study of acupuncture and its role in immune regulation explores how this ancient therapy influences modern medical understanding. The figure visually presents the mechanisms through which acupuncture may modulate immune responses. The first image is a flowchart that details the process of research analysis, emphasizing the rigorous methodologies employed to ensure the reliability of the results. The second image illustrates the intersection of Traditional Chinese Medicine and modern network medicine, highlighting the fusion of ancient herbal knowledge with modern frameworks. Finally, the comparison of hand positioning provides a subtle observation of the physical aspects of acupuncture practice, emphasizing the technical variations that may influence treatment outcomes. These data underscore the multifaceted approaches to understanding how acupuncture regulates immune function, linking traditional practices with cutting-edge research methodologies [22,38,39].

4.3 Technological Advances in Acupuncture Practice

Technological advancements have transformed acupuncture practice by enhancing training and application through innovative tools and systems. The Virtual Reality Acupuncture Training System (VRATS) provides an immersive 3D visualization of human anatomy and acupuncture points, enriching the educational experience for practitioners [43]. This system offers a comprehensive understanding of the spatial relationships between acupuncture points and anatomical structures, which is crucial for accurate needle placement and effective treatment.

Açu VR has contributed to the modernization of acupuncture training by creating a safe environment where practitioners can receive real-time feedback during practice, visualizing anatomical relationships [36]. This functionality improves the precision of acupuncture techniques and allows skills to be refined in a risk-free setting, enhancing practitioner competence. Face Atlas AR represents another technological leap by enabling real-time identification of facial acupuncture points. It adapts to various head positions and user experience levels, benefiting both novices and experienced practitioners [41]. The precise localization of acupuncture points improves the efficacy of facial acupuncture and expands the accessibility of treatments. The integration of advanced visualization and feedback systems, such as VR and 3D models, provides transformative opportunities to enhance education and clinical outcomes. These technologies improve the understanding of anatomy and techniques by providing immersive experiences, addressing the challenges of traditional acupuncture training. Acu VR offers a more intuitive learning environment than traditional 2D resources, while the HBot chatbot facilitates real-time consultations and training by intuitively highlighting acupuncture points. In summary, these innovations streamline learning for students and practitioners, improve treatment outcomes, and bridge Traditional Chinese Medicine with evidence-based medicine [36,42,43]. By combining traditional techniques with modern technologies, these advancements deepen the understanding of acupuncture mechanisms and promote the integration of acupuncture with modern healthcare.

5. Integrating Traditional Chinese Medicine with Western Medicine

Integrating TCM with Western medicine is gaining attention for its potential to enhance therapeutic outcomes by combining the strengths of both medical systems through a holistic, patient-centered approach. This method aims to address both physical symptoms and underlying health determinants by integrating personalized treatments from TCM, such as acupuncture, Chinese herbal medicine, and Qigong, with evidence-based interventions from Western medicine. By leveraging the advantages of both systems, integrative medicine provides innovative treatment strategies for managing complex diseases, including autoimmune conditions. The following sections will discuss the benefits, challenges, technological advancements, evidence-

based research, and future directions of this collaborative framework.

5.1 Benefits of Integrating TCM with Western Medicine

Integrating TCM and Western medicine creates a synergistic framework by combining TCM's holistic and personalized approach with Western medicine's precise interventions to optimize patient treatment outcomes. Methods such as acupuncture, Chinese herbal medicine, and syndrome differentiation not only target symptomatology but also address underlying pathophysiological mechanisms. For example, polysaccharides in Chinese herbs can modulate immune responses and reduce inflammation, while acupuncture at points like ST36 can regulate cytokine production, enhancing the effects of Western anti-inflammatory therapies [39,45]. This dual approach promotes comprehensive treatment, improves therapeutic outcomes, and fosters a deeper understanding of disease mechanisms [3,27,46]. The personalized treatment strategies in TCM, tailored to the individual patient, align closely with Western diagnostic precision, enhancing clinical decision-making and patient-centered care. For instance, the SMGCN framework models the syndrome induction process and, when combined with TCM and Western methods, can improve treatment efficacy [26]. Moreover, innovative technologies like HBot, a chatbot that visualizes acupuncture points and provides TCM-related consultations, demonstrate how technology can facilitate integrative practices and increase accessibility [42]. These tools address gaps in traditional healthcare, promote collaborative environments, and enhance patient engagement. Incorporating TCM into health policies has shown its potential in addressing gaps in research and improving healthcare accessibility. Studies conducted during the COVID-19 pandemic highlighted the efficacy of TCM in reducing ICU admissions and preventing severe cases, showcasing its potential in broader healthcare systems [15]. Long-term studies on interventions like acupuncture indicate that their therapeutic effects can be sustained, further supporting the inclusion of TCM in integrative treatment plans [47]. By combining immune regulation strategies, personalized interventions, and advanced technologies, integrative medicine offers transformative solutions for managing autoimmune and chronic diseases [8,9,48].

5.2 Challenges of Integrating TCM with Western Medicine

Despite its benefits, the integration of TCM with Western medicine faces several challenges, including a lack of standardized methods, regulatory barriers, and practice differences. The inconsistent evaluation methods for TCM interventions, including acupuncture, hinder reliable comparisons and limit the application of integrative practices. Existing benchmarks often fail to account for key aspects of TCM, such as personalized treatment strategies and detailed interventions, making evidence-based evaluations more complex [19,49]. Bridging these gaps requires the development of better guidelines that reflect the uniqueness of TCM while aligning with Western scientific standards.

Regulatory barriers further hinder integration, as differences in the mechanisms of Chinese herbal treatments and stringent registration requirements impede the widespread acceptance of herbal medicine. Efforts to combine TCM practices with evidence-based approaches are constrained by these frameworks, limiting its global application [48]. Additionally, the diversity of TCM practices, influenced by cultural and regional differences, complicates the creation of standardized protocols, affecting the reproducibility and scalability of research [50]. Overcoming these challenges requires coordinated projects that preserve the traditional roots of TCM while ensuring consistency in practice. Innovative solutions, such as integrated benchmarks and interdisciplinary guidelines, are essential to closing the methodological gaps. These efforts should combine the personalized principles of TCM with the rigorous methodologies of Western medicine, enhancing transparency in research practices and strengthening clinical decision-making. Advanced data warehouse technologies and standardized ter-

minologies can support drug development and educational activities, promoting a unified understanding of TCM within the modern medical framework [9,17].

5.3 Technological Advances in Integrating TCM with Western Medicine

Technological innovations have significantly driven the integration of TCM with Western medicine by enhancing diagnostic accuracy, personalizing treatments, and improving system modeling, which has boosted the effectiveness of integrative therapies. As illustrated in Figure 3, these advances can be categorized into three main areas: artificial intelligence (AI) and language models, immersive technologies, and personalized deep learning. Each area highlights specific tools and frameworks for improving diagnostic precision, treatment personalization, and training methods.

Large language models, such as Bian Que, have optimized TCM diagnosis and syndrome typing through domain-specific training and clinical case databases, improving retrieval accuracy and evidence-based applications. Frameworks like FMCHS combine the chemical characteristics of herbs with clinical symptoms, improving the accuracy of herb recommendations and advancing personalized healthcare [8,11,51]. AI-driven tools, such as the QiBo benchmark, simulate herb-symptom relationships and predict therapeutic effects, promoting

the application of TCM concepts in clinical settings. These advancements enhance the precision of herbal prescriptions and the scalability of integrative practices [31].

Virtual reality (VR) and augmented reality (AR) platforms, like Acu VR and Face Atlas AR, have revolutionized acupuncture training by offering immersive environments for skill improvement and real-time anatomical visualization. These tools combine traditional TCM knowledge with evidence-based practices, ensuring treatment accuracy and efficacy [41,43,52]. Deep learning models further enhance the personalization of TCM by analyzing patient-specific characteristics and generating customized treatment recommendations. Frameworks like TOSRR and distributed representation technologies improve diagnostic accuracy and herb prescriptions, aligning with TCM's emphasis on personalized care [17,28]. By combining these computational advances with Western diagnostic tools, TCM practices achieve higher consistency and reliability in clinical applications.

The integration of AI, VR, AR, and system modeling frameworks has transformed integrative medicine, promoting interdisciplinary collaboration and innovation. These technologies ensure the continued development of TCM practices, providing scalable and precise solutions for managing complex conditions [11,17,53].
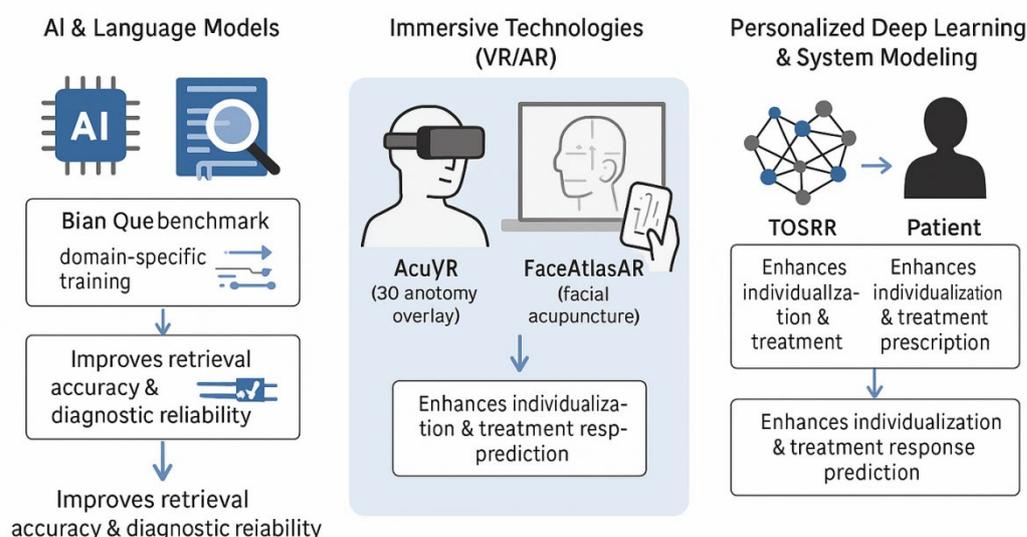

Figure 3: Technological Advances Driving TCM-Western Medicine Integration.

5.4 Evidence-Based Research in Integrating TCM with Western Medicine

Evidence-based research is crucial for the integration of Traditional Chinese Medicine (TCM) with Western medicine, as it provides a structured approach to assessing the efficacy, safety, and applicability of treatments. Rigorous methodologies, such as double-blind studies and advanced data repositories, enhance the reliability of clinical data and foster collaboration between TCM and Western medicine professionals [3,9,27]. However, discrepancies in the measurement of outcomes between TCM and Western medicine trials highlight the necessity for standardized protocols [54].

Innovative frameworks, such as the Chinese Herbal Prescription Benchmark, optimize integrative therapies by merging traditional TCM methods with modern scientific paradigms. These benchmarks refine treatment models, improving precision and applicability [55]. International efforts to standardize TCM practice, focusing on quality control and aligning with Western regulatory standards, aim to enhance global competitiveness and interdisciplinary collaboration [48]. To bridge research gaps, standardized reporting protocols, increased transparency, and interdisciplinary efforts are required. AI-driven tools, such as syndrome typing benchmarks, further advance the empirical validation of TCM theory and support the development of integrative medicine [11,12]. By combining traditional practices with modern scientific principles, evidence-based research is driving the integration of TCM and Western medicine.

5.5 Future Directions for Integrating TCM with Western Medicine

Future research in the integration of TCM and Western medicine should prioritize elucidating the mechanisms of mutual influence, such as the immune-regulatory effects of acupuncture on cytokine modulation and neurohormonal pathways. Understanding these mechanisms will strengthen the scientific foundation of TCM and integrate it into Western medicine [20]. AI-driven frameworks, such as TCM-Prompt and TCM-FTP, can further optimize herb-symptom analysis and personalized treatment strategies, improving the precision and scalability of integrative therapies [28,53]. Standardizing TCM methods, including syndrome typing and herbal formulations, is critical to ensuring consistency and reproducibility. Collaborative guidelines that reflect both TCM's holistic principles and Western evidence-based methods will bridge the methodological gap and promote interdisciplinary cooperation [9,48]. Technological advancements, such as VR and AR platforms, should be leveraged to improve diagnostic accuracy and practitioner training, thus enhancing the precision of integrative therapies [36,41]. Long-term studies on integrative therapies, particularly for chronic diseases like Sjögren's syndrome, are necessary to evaluate their sustained efficacy and safety. The internationalization of TCM should align with global regulatory standards, ensuring broader accessibility and credibility [19,47]. By addressing these issues, integrative medicine can develop into a robust framework for managing complex diseases, combining TCM's unique methods with Western scientific validation, ultimately transforming healthcare [3,9].

6. Advancing Sjögren's Syndrome Management

6.1 Clinical Trials and Research Overview

Research on TCM in the treatment of Sjögren's syndrome includes a range of clinical trials and studies, reflecting its potential in managing autoimmune diseases. Acupuncture research shows significant efficacy in pain management and the treatment of inflammatory conditions, though challenges such as small sample sizes and inconsistent laser acupuncture parameters remain, requiring further rigorous research [3,21]. In herbal treatments, syndrome-aware herbal recommendation systems, evaluated using large TCM datasets, highlight the necessity for precise herb selection and scoring, with models like Qibo excelling in both subjective and objective assessments [26,31]. The integration of modern technologies further drives the development of TCM research, with comprehensive datasets, such as TCM-ED, providing valuable resources and supporting

meta-analyses to enhance understanding of TCM efficacy [11,32].

TCM clinical trials aim to combine traditional practices ─ acupuncture, herbal medicine, and Qigong─with modern methods, including double-blind designs and data-driven analyses, to validate the efficacy and safety of TCM within Western biomedical frameworks. While there are challenges in methodological rigor and data integration, ongoing research continues to elucidate the potential of TCM in managing autoimmune diseases, improving patient outcomes, and expanding treatment options [3,11].

6.2 Clinical Efficacy Studies and Methodology

Assessing the efficacy of TCM involves various methods to capture its complex interactions and effects. The NP-TCM target model enhances intervention precision by linking predicted effects with biological outcomes [13]. The network medicine framework measures the proximity between herbs and symptoms, aligning with TCM's holistic principles and identifying new therapeutic targets [22]. Advanced modeling techniques, such as RFIT and RoKEPG, explore the dynamic relationships between herbs and symptoms through statistics like precision, recall, and F1 score, improving prescription accuracy [24,25]. Syndrome-aware herbal recommendation systems focus on accurate herb scoring, while TCM Bench evaluates the semantic consistency of large language models (LLMs) in TCM [26,32]. THC luster improves the accuracy of herb classification, enhancing the precision of TCM efficacy studies [5]. Future research should control for confounding factors such as anatomical locations and needle depth to optimize acupuncture assessments [38]. These methods demonstrate a commitment to rigorous scientific evaluation, combining traditional practices with modern technologies to validate TCM's efficacy and promote dialogue between traditional and modern research [3,10,11,28,30]. These efforts advance the understanding and application of TCM in managing complex conditions like Sjögren's syndrome, improving patient care.

6.3 Theoretical Models and Scientific Validity

Exploring theoretical models and scientific validity is crucial for bridging TCM with modern scientific paradigms. The acupuncture mechanical wave model, proposed by Luo et al., provides a coherent explanation for the physiological effects of acupuncture, enhancing TCM's credibility [6]. Experimental data supporting the study of interstitial fluid (ISF) pathways activated by acupuncture points validate the meridian network and provide insights into acupuncture's physiological impacts [37]. Incorporating advanced statistical models, such as BART, enhances estimates of TCM efficacy by detecting interactions and nonlinearity in complex datasets [56]. These models and advancements highlight the potential for integrating TCM with modern scientific frameworks, deepening understanding of its mechanisms and benefits. Establishing a scientific foundation for TCM supports the integration of concepts like multi-target effects of herbal medicine and acupuncture principles into Western paradigms, promoting its widespread application and acceptance in integrative medicine [3,27,30].

6.4 Technological Advancements and Methodological Innovations

Technological advancements and methodological innovations are transforming TCM research. Augmented Reality (AR) technology improves the effectiveness of herbal medicine education by providing interactive learning experiences, enhancing cognitive retention and clinical practice [35]. Virtual Reality (VR) applications in acupuncture provide immersive training experiences, combining traditional techniques with modern capabilities [43]. Combining TCM with microbiome research represents the frontier of methodological innovation, revealing new therapeutic pathways and enhancing efficacy [57]. These advancements highlight the potential of TCM in modern scientific environments, expanding treatment applications, and supporting integrative medicine strategies. Through clinical trials and emerging research strategies like Chinmedomics, TCM practices are being validated, pro-

moting its acceptance in traditional healthcare systems and advancing the understanding of TCM's role in managing complex health issues [3,27].

6.5 Gaps and Limitations in Current Research

Exploring the application of TCM in Sjögren's syndrome faces gaps and limitations, hindering a comprehensive understanding and application of TCM. The diversity of research methodologies complicates generalization and prediction accuracy [23]. Methodological limitations, such as small sample sizes and biases, weaken the effectiveness of clinical findings [3]. Gaps in understanding molecular mechanisms require comprehensive datasets and exploration of the relationship between TCM and the gut microbiome [23]. Existing models' limitations in handling observational data underscore the need for innovative approaches [33]. Specific challenges related to acupuncture make its integration into mainstream healthcare more complex [38]. Future research should expand datasets, integrate multimodal data, and optimize retrieval mechanisms to improve diagnostic accuracy [11]. Addressing these gaps and limitations is crucial for advancing the scientific validation of TCM and its integration into modern healthcare systems, fostering deeper understanding and communication between conventional medicine and TCM practitioners [3,10,11,33].

7. Challenges and Future Directions

The integration of Traditional Chinese Medicine with mainstream healthcare presents several challenges that must be addressed to facilitate a seamless transition from traditional practices to evidence-based methods. Understanding these challenges is crucial for enhancing the acceptance and application of TCM in modern healthcare environments. The following sections will explore the specific integration challenges faced by TCM, emphasizing the complexities of combining traditional methods with modern medical standards. A deep study of these challenges will shed light on the current barriers and guide future research directions.

7.1 Integration Challenges

Integrating TCM into mainstream medical practice involves aligning traditional concepts with modern scientific understanding. A significant challenge is the variation in individual responses to treatments like acupuncture, which complicates the generalizability of research findings and the development of standardized clinical guidelines [26]. Despite evidence supporting the efficacy of acupuncture, efforts to incorporate it into clinical guidelines have been hindered by limited research funding and support [23]. Moreover, the mechanisms of therapies such as laser acupuncture remain unclear, and the varied parameters and methods further obstruct the establishment of clear clinical guidelines [27]. Reliable research methods must be employed to elucidate these mechanisms and gain biomedical recognition. Advanced models such as Bayesian Additive Regression Trees (BART) show potential for enhancing treatment evaluation by incorporating external data sources, but future research must refine these models to adapt to diverse data applications [32]. Efforts to enhance models like Bian Que for broader TCM fields are critical for improving healthcare accuracy and relevance [57]. Cooperation between traditional practitioners and data scientists is essential to develop complex analytical frameworks. As seen in MedChatZH, expanding the language and domain of specialized models is crucial for promoting TCM practices in various clinical settings [36]. Overcoming language barriers and cultural differences will make TCM more inclusive. Harmonizing traditional TCM concepts, such as meridian theory, with modern physiology remains a long-term challenge [25]. Future research should focus on expanding frameworks like TCMDA to validate and enhance the integration of TCM [24]. Interdisciplinary collaboration and modern research technologies are key to better integrating TCM into mainstream healthcare.

7.2 Standardization and Validation

The standardization and validation of TCM practices are vital for their integration into contemporary healthcare systems. Aligning TCM's holistic paradigm with strict scientific standards ensures consistency and reliability across different clinical

environments. The Human Interstitial Fluid Connectivity Atlas serves as an example of validating meridian theory from an anatomical perspective [10]. Technological advancements, such as improvements in facial acupuncture techniques, have enhanced the accuracy of line placement and explored 3D interactions [28]. These innovations refine acupuncture practice and improve its applicability in clinical settings.

Standardized vocabularies like the Integrated Symptom Phenotype Ontology (ISPO) provide a framework for analyzing symptom phenotypes and meridian pathways [34]. Expanding ontologies to encompass compound symptoms will enhance the semantic interoperability of TCM data. Models such as NP-TCM target, which use network pharmacology to identify the targets of Chinese medicine ingredients, address challenges in standardization and validation [14]. Despite progress, TCM practices still vary across regions, highlighting the need for standardized guidelines and quality control measures [33]. The TCMSD benchmark emphasizes the need for improving data quality and NLP tasks to enhance model accuracy [22]. Expanding datasets and refining methodologies will drive TCM standardization and validation [13]. Frameworks like QiBo provide a structure for evaluating TCM models, contributing to the development of standardized practices and technologies [35]. These efforts ensure that TCM practices align with modern medical standards.

7.3 Future Research Directions

Future TCM research should clarify the interactions between the neuroendocrine and immune systems, employing systems physiology methods to deepen our understanding of acupuncture's effects [3]. Expanding datasets and refining classification methods will improve the understanding of side effects and treatment outcomes. AI models based on ontologies, such as those proposed by Yao et al., suggest exploring factors influencing side effects to enhance prediction accuracy [58]. Comprehensive benchmarks like CMB for evaluating large language models in TCM could potentially extend to

other medical fields [31]. Underfunded areas like depression and migraines should receive more research attention, incorporating existing evidence into healthcare decision-making [23]. Real-world clinical evaluations and the integration of diverse data will apply TCM models to other healthcare fields [37]. To clarify the physiological effects of laser acupuncture, reliable studies with standardized laser parameters are needed [27]. Improving data quality and adopting advanced methods will enhance Chinese herbal medicine prescriptions and herbal combinations [5]. Applying models like Random Forest Interaction Trees (RFIT) to observational data will provide potential advancements in understanding treatment effects [11]. Addressing exposure bias and integrating contrastive learning techniques will improve prescription generation models [7]. Optimizing processing methods and establishing standardized protocols will enhance the clinical application of Chinese herbal medicine [33]. Exploring deep learning techniques for estimating entity probabilities will refine models like THC luster, advancing herbal classification [8].

7.4 Technological Advancements

Technological advances have significantly impacted TCM research and practice, improving efficacy and facilitating its integration into modern healthcare systems. Advanced computational models, like NP-TCM target, use network pharmacology to identify herbal ingredient targets, providing scientific backing for TCM [14]. For example, Face Atlas AR utilizes augmented reality and deep learning to provide real-time visualization of acupuncture points, improving precision and effectiveness [28]. These innovations enhance treatment outcomes and patient satisfaction. NLP techniques applied to TCM, with the help of structured datasets like TCMSD, promote research by analyzing the complex relationships between herbs, symptoms, and diseases [22]. Models such as RoKEPG integrate traditional practices with modern technology, enhancing prescription generation capabilities [7]. Comprehensive benchmarks like QiBo help evaluate TCM

large language models, contributing to the standardization and validation of practices [35]. These advancements ensure that TCM practices align with modern healthcare standards, promoting a comprehensive approach to patient care.

8. Conclusion

The integration of TCM in treating Sjögren's syndrome (SS) is a transformative approach to addressing the complexities of this systemic autoimmune disease. By focusing on both symptom relief and underlying pathophysiological mechanisms, TCM provides a holistic framework that complements traditional medical models. This review highlights the potential of TCM therapies, such as syndrome typing, herbal medicine, and acupuncture, to regulate immune responses, alleviate chronic inflammation, and relieve the multifaceted symptoms of SS. These therapeutic strategies, when combined with modern scientific advancements, underscore the future prospects of TCM as a personalized and integrative approach to patient care.

Chinese Herbal Medicine remains the cornerstone of TCM, with innovations like the Chinmedomics framework and technologies such as THC luster improving the precision and efficacy of herbal formulations. The immune-regulatory properties of bioactive compounds, including polysaccharides, further emphasize the therapeutic value of Chinese herbs, while advancements in extraction methods and quality control protocols pave the way for safer, more effective applications. These developments not only strengthen the scientific foundation of TCM but also promote its integration with evidence-based medical practices. Modern technologies like Artificial Intelligence, multi-omics, and network pharmacology have revolutionized TCM research and clinical applications. AI-driven tools improve diagnostic accuracy, syndrome typing, and herbal prescription modeling, while multi-omics and network pharmacology offer molecular insights into TCM interventions. However, the variability in research design and the lack of standardized methods remain significant challenges, making it essential to conduct rigorous validation and establish uniform research protocols to enhance the credibility of TCM in the global medical community.

The synergistic integration of TCM with Western medicine has demonstrated immense potential in bridging gaps within traditional healthcare systems. Advancements in symptom terminology standardization, such as the development of the ISPO ontology, have enhanced data interoperability and fostered interdisciplinary collaboration. Future work should prioritize expanding multimodal datasets, improving AI-assisted diagnostic tools, and conducting multi-center clinical trials to validate the safety and efficacy of TCM interventions. Addressing these priorities will foster a more cohesive healthcare model, utilizing the strengths of both TCM and Western medicine to improve treatment outcomes and patient satisfaction. This collaborative approach has the potential to redefine the landscape of integrative medicine, offering innovative solutions to complex challenges like Sjögren's syndrome and other chronic diseases.

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