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Progress in the application of case-based teaching model in clinical instruction of traditional Chinese medicine neurology department

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Abstract. Traditional clinical teaching in the department of traditional Chinese medicine neurology tends to emphasize knowledge transmission at the expense of clinical reasoning training. The case-based teaching model addresses this issue by using authentic clinical cases as its core teaching resource, thereby aligning with the requirements for developing students' ability to diagnose and treat diseases based on syndrome differentiation. This study systematically reviews the application of the CBS-RISE model, including the stratified design of cases according to disease and syndrome complexity and students' cognitive development; the provision of resources such as literature and clinical guidelines to encourage independent inquiry; and the organization of group discussions and teacher feedback to clarify diagnostic reasoning based on syndrome differentiation. The results indicate that this model can improve students' clinical reasoning skills in traditional Chinese medicine, promote independent learning, and enhance the overall quality of clinical teaching. Future improvements may focus on developing a database of representative clinical cases, coordinating hardware and software resources, and establishing a multidimensional teaching quality evaluation system. These measures may provide practical guidance for clinical teaching reform in the department of traditional Chinese medicine neurology.

Keywords: CBS-RISE teaching model, department of traditional Chinese medicine neurology, clinical teaching, case-based learning, syndrome differentiation and clinical reasoning

1. Introduction

As one of the key core branches of Traditional Chinese Medicine (TCM), TCM neurology plays an important role in clinical education. Clinical teaching in this field serves two main purposes: helping students develop a solid foundation in TCM theory and guiding them in developing clinical reasoning based on syndrome differentiation and treatment, as well as the practical ability to manage complex neurological conditions. However, traditional didactic teaching remains widely used in clinical instruction in TCM neurology. In this approach, teachers deliver knowledge unilaterally, while students passively receive information. The limitations of this model are particularly evident in its failure to stimulate students' learning motivation and

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adequately develop their clinical reasoning and practical skills. Most students become accustomed to memorizing key points by rote, without developing the ability to conduct in-depth analyses of actual clinical cases or make independent judgments. Consequently, they struggle to apply theoretical knowledge effectively in real clinical settings, ultimately preventing them from achieving the expected level of comprehensive clinical competence. Therefore, exploring new teaching models that align with the fundamental principles of syndrome differentiation and treatment in TCM, place students at the center of the learning process, and emphasize problem-oriented guidance and independent inquiry has become an urgent priority in clinical teaching reform in TCM neurology.

The CBS-RISE teaching model, an inquiry-based approach centered on cases and supported by learning resources, offers a feasible solution to the current challenges in TCM clinical education. This model uses authentic or highly realistic simulated clinical cases to create teaching scenarios and guides students through the active construction and internalization of knowledge by means of independent literature searches, collaborative group discussions, and targeted guidance from teachers. Its underlying educational philosophy places students at the center of the learning process and emphasizes problem-oriented learning and independent inquiry. These characteristics align closely with the reasoning process underlying TCM's approach to syndrome differentiation and treatment, particularly the principles of "examining the manifestations of a syndrome to identify its underlying cause" and "determining treatment according to the syndrome presented". Existing studies have shown that case-based teaching can effectively improve students' mastery of knowledge, clinical proficiency, and overall competence while substantially increasing their satisfaction with the teaching process [1]. In addition, the Case-Based Learning (CBL) model has been shown to have a clear positive effect on the development of students' critical thinking and clinical decision-making abilities [2]. Applying the CBS-RISE model to clinical teaching in TCM neurology can address the shortcomings of traditional teaching approaches while allowing students to deepen their understanding of the fundamental principles of TCM and strengthen their practical ability to differentiate syndromes and determine treatment through engagement with realistic clinical scenarios and the management of actual cases. Ultimately, this approach can help cultivate TCM neurology professionals with stronger clinical competence.

This study focuses on reviewing the specific implementation methods, application outcomes, and optimization strategies associated with the CBS-RISE teaching model in clinical teaching in TCM neurology. By synthesizing existing research findings, it seeks to identify the model's advantages in developing students' clinical reasoning skills and independent learning awareness and improving teaching satisfaction. It also examines the key implementation considerations and potential practical challenges involved in adapting the model to the distinctive teaching scenarios of TCM neurology. The findings are expected to provide a solid theoretical foundation and practical guidance for reforming clinical teaching models in TCM neurology and progressively improving the quality of clinical education in this field.

2. Theoretical foundations of the CBS-RISE teaching model and its compatibility with clinical teaching in TCM neurology

2.1. Core components of the CBS-RISE teaching model

The CBS-RISE teaching model centers on the deep integration of case-driven learning and resource-oriented inquiry. Its underlying theoretical foundation is the Case-Based Reasoning (CBR) model. This model suggests that when faced with unfamiliar problems, people rely not only on general rules but also, and often more readily, retrieve specific cases from their past experiences stored in memory and use them as a knowledge base

for decision-making [3]. In medical settings, this reasoning process closely reflects the characteristics of clinical practitioners' diagnostic and treatment thinking. The common clinical expression "I have treated a patient with a similar condition before" exemplifies the use of experience derived from previous cases to inform current diagnostic and treatment decisions [4]. The CBS-RISE teaching model applies this cognitive principle to education by using authentic clinical cases or highly realistic simulated clinical scenarios as the starting point for learning. It guides students through the entire process of identifying and analyzing problems independently. This case-centered approach can effectively stimulate students' intrinsic motivation to learn and help them construct their own knowledge frameworks within specific clinical contexts. At the same time, the model adopts a resource-oriented approach, encouraging students to conduct independent inquiry using a variety of resources, including textbooks, academic literature, and specialized databases. This approach closely corresponds to the core operational logic of knowledge acquisition and integration in case-based reasoning systems: retrieving and reusing established solutions from previous cases to address new clinical problems [5]. In clinical teaching in TCM neurology, neurological conditions are diverse, and their syndrome classifications vary considerably. Traditional one-way theoretical instruction alone is insufficient to help students develop structured clinical reasoning and diagnostic and treatment skills. The CBS-RISE model uses authentic cases as learning vehicles, exposing students directly to actual or simulated cases involving neurological conditions such as stroke, vertigo, and dementia. Students are encouraged to actively consult classical TCM texts, contemporary research findings, and clinical diagnosis and treatment databases, thereby developing essential skills in information retrieval, organization, and integration. Furthermore, the model emphasizes interaction and immediate feedback throughout the learning process. Group discussions, two-way communication between teachers and students, and staged learning presentations help reinforce students' self-reflection and enable them to adjust their learning approaches as needed. This process corresponds directly to the case revision and retention stages of case-based reasoning systems. Through repeated comparisons of the similarities and differences between new and existing cases, students iteratively refine established solutions and ultimately incorporate newly acquired experience into a case library for future use [6]. In clinical teaching practice in TCM neurology, this bidirectional feedback mechanism guides students to approach syndrome differentiation and treatment from multiple perspectives. The collective consensus developed through team discussions helps correct individual cognitive biases in syndrome differentiation, thereby further deepening students' understanding of the underlying principles governing the diagnosis and treatment of neurological conditions in TCM.

2.2. Special characteristics of clinical teaching in TCM neurology

Neurological conditions treated in TCM neurology, including stroke, vertigo, and dementia, are typically characterized by complex etiologies and pathogenesis, evolving syndromes, prolonged disease courses, and difficulties in achieving a cure. These characteristics require students not only to possess a solid foundation in TCM theory but also to develop the ability to apply syndrome differentiation flexibly when addressing clinical problems. In clinical teaching, instructors must guide students in mastering traditional diagnostic and therapeutic techniques, such as the comprehensive application of the four diagnostic methods of TCM and meridian-based syndrome differentiation. At the same time, they must actively incorporate knowledge from related disciplines, including modern neuroimaging and pathophysiology, to achieve the effective integration of TCM and Western medicine [7]. This places higher demands on students' overall clinical competence. Traditional clinical teaching approaches have generally emphasized the one-way transmission of knowledge while neglecting the systematic development of students' clinical reasoning skills. Consequently, these

approaches have struggled to meet the specific requirements of TCM neurology for clinical reasoning based on syndrome differentiation, resulting in overall teaching quality falling short of expectations [8].

2.3. Advantages of integrating the CBS-RISE model into clinical teaching in TCM neurology

The CBS-RISE teaching model offers distinctive advantages in terms of synergy and compatibility when applied to clinical teaching in TCM neurology. First, the case-guided learning component can recreate typical diagnostic and treatment scenarios encountered in TCM neurology. For example, separate clinical scenarios can be developed for the acute and recovery phases of stroke to help students accurately distinguish the differences in syndrome manifestations between these two stages. This approach supports the development of a complete reasoning sequence in syndrome differentiation, from symptom identification to syndrome summarization [9]. By grounding learning in authentic clinical scenarios, this method enhances the clinical relevance of the learning process and encourages students to systematically identify the key elements of syndrome differentiation at different stages of disease onset and progression [10]. Second, the resource-support component encourages students to independently consult classical TCM texts, such as *Huangdi Neijing* (*The Yellow Emperor's Inner Canon*) and *Shanghan Zabing Lun* (*Treatise on Cold Damage and Miscellaneous Diseases*), as well as recent research findings. This helps consolidate students' theoretical understanding of the principal etiological factors and pathogenesis underlying neurological conditions while developing their capacity for independent inquiry and systematic knowledge organization [11]. By cross-referencing classical theories with cutting-edge research, students can develop a more systematic understanding of the multidimensional pathological mechanisms underlying neurological conditions. Third, the discussion and collaboration component provides a platform for the detailed analysis of complex clinical cases. For example, when examining challenging cases involving dementia accompanied by depressive syndromes, in which multiple zang-fu organs are affected and several pathological factors interact, students can participate in group discussions and simulated clinical scenarios. These activities enable them to analyze syndrome differentiation from multiple perspectives, thereby effectively improving their clinical judgment and developing a more comprehensive approach to diagnosis and treatment [12]. This multifaceted, interactive learning approach effectively addresses the disconnect between theoretical instruction and clinical practice that characterizes traditional teaching models. It provides a reliable pathway for cultivating specialists in TCM neurology who possess both a profound grounding in TCM theory and the ability to respond effectively to urgent clinical situations.

3. Implementation strategies for the CBS-RISE teaching model in clinical teaching in TCM neurology

3.1. Case design and selection

The successful implementation of the CBS-RISE teaching model depends primarily on the selection and structured design of clinical cases, which directly determine the effectiveness of teaching. In clinical teaching in TCM neurology, the selected cases should systematically cover common conditions, including stroke, headache, insomnia, and epilepsy, while highlighting the dynamic evolution of syndromes as diseases progress. For example, a stroke case can present the complete transition from *wind-yang disturbing the upper body* in the acute phase to *qi deficiency and blood stasis* in the recovery phase. Presenting these dynamic changes throughout the disease course helps students develop an understanding of disease progression and strengthen their ability to adapt syndrome differentiation and treatment to changing clinical conditions. Case

materials should include comprehensive information obtained through the four diagnostic methods of TCM, including tongue and pulse characteristics, clinical manifestations, and medical history. Modern imaging findings, such as Computed Tomography (CT) and Magnetic Resonance Imaging (MRI), should also be incorporated appropriately to cultivate students' clinical reasoning skills in integrating TCM and Western medicine. Existing research has demonstrated that combining neuropsychological assessments with imaging examinations can improve diagnostic accuracy in neurological conditions such as hepatic encephalopathy [13]. This finding provides a useful reference for designing teaching cases in TCM neurology. Case difficulty should increase progressively. Teaching should begin with typical cases involving a single syndrome, such as insomnia caused solely by *phlegm-turbidity obstructing the orifices*, before gradually progressing to complicated cases involving multiple concurrent syndromes, such as patients with post-stroke sequelae characterized by both *intermingled phlegm and blood stasis* and *liver-kidney yin deficiency*. This progression from simple to complex helps students gradually establish a structured framework for clinical reasoning based on syndrome differentiation and prevents their learning confidence from being undermined by exposure to overly difficult material at the outset. During case design, additional information related to the pathogenesis of hepatic encephalopathy can also be incorporated, including the relationship between hyperammonemia and cerebral edema [14] and the mediating role of disordered ammonia metabolism in the onset and progression of encephalopathy [15]. This approach helps students develop a deeper understanding of the relationship between the fundamental TCM concept of *phlegm-turbidity obstructing the clear orifices* and modern pathophysiological knowledge. With the support of a systematically developed case database, students can not only master the key principles of syndrome differentiation in TCM but also improve their ability to interpret and evaluate the results of modern medical investigations, thereby establishing a solid foundation for their subsequent clinical practice.

3.2. Resource guidance and independent learning

In TCM education, resource guidance and independent learning are essential approaches to developing students' clinical reasoning and strengthening their ability to address clinical problems independently. Instructors should first organize and provide a directory of core learning resources, including passages from classical TCM texts, current industry standards and clinical practice guidelines, and academic literature databases. These resources help students establish a structured foundation of knowledge. This student-centered teaching approach emphasizes students' active responsibility for their own learning and uses representative clinical cases to stimulate their willingness to explore and investigate independently [16]. Existing research has shown that case-based teaching can effectively improve students' mastery of knowledge and long-term retention. For example, in anatomy courses, students taught using CBL achieved greater improvements in test scores than those taught through traditional didactic instruction and also demonstrated better long-term knowledge retention [17].

Instructors divide students into several groups and formulate questions around specific cases to guide literature searches and information organization. Each group then prepares a preliminary case analysis report. This learning process not only develops students' abilities to evaluate, summarize, and integrate information but also fosters teamwork and critical thinking through collaborative activities. By recreating authentic clinical diagnostic and treatment scenarios, case-based teaching establishes a bridge between theoretical knowledge and clinical practice, effectively strengthening students' clinical reasoning and decision-making abilities [2]. Meanwhile, instructors should regularly monitor the learning progress of each group and use targeted questions, short in-class quizzes, and other methods to direct students' attention to key issues and prevent them from losing focus during the information retrieval stage. Such guided intervention helps ensure that the

learning process remains aligned with the intended teaching objectives while further consolidating students' mastery of essential knowledge. Existing research indicates that combining case-based teaching with timely instructor guidance can improve classroom participation and students' perceived learning gains. The effects are particularly evident in the development of students' abilities to analyze problems, evaluate evidence, and engage in deductive reasoning [18]. Furthermore, resource-guided independent learning enables students to develop a deeper understanding of the fundamental principles of syndrome differentiation and treatment in TCM, allowing them to apply classical TCM theories in conjunction with current clinical guidelines when addressing practical diagnostic and treatment problems. Through the combined effects of collaborative group inquiry and targeted feedback from instructors, students gradually transition from passively receiving information to actively constructing knowledge, thereby laying a solid foundation for their subsequent entry into clinical practice.

3.3. Discussion and feedback

In TCM education, group discussion is an important means of developing students' clinical reasoning skills based on syndrome differentiation. Students take turns presenting their reasoning processes when analyzing clinical cases. For example, they may identify blood stasis obstructing the internal circulation based on the tongue manifestation of a "dark-purple tongue" and further confirm impaired blood circulation by considering the pulse manifestation of a "choppy pulse". This process closely integrates the fundamental theories of TCM with actual clinical scenarios. During the discussion, instructors provide targeted feedback and supplement students' analyses with key diagnostic features, such as the fact that blood stasis obstructing the internal circulation is often accompanied by characteristic manifestations including stabbing pain and pain at a fixed location. This guidance helps students gradually establish a comprehensive framework for syndrome differentiation. Existing research has shown that teaching approaches incorporating group discussions can improve students' clinical practice skills. For example, in a teaching module on risk factor counseling, students who participated in both group discussions and role-playing exercises achieved higher scores in skills assessments than those who received only conventional classroom instruction [19]. Group discussions also deepen students' understanding of complex and challenging cases. Through collective analysis, students can develop a consistent diagnostic and treatment approach, thereby improving the accuracy of syndrome differentiation and treatment [20]. This interactive learning model not only stimulates students' initiative in learning but also enables instructors to correct common errors in syndrome differentiation through immediate feedback, such as overlooking the importance of interpreting tongue and pulse findings in conjunction with each other.

Role-playing is a commonly used teaching method for developing students' overall professional competence through simulated clinical scenarios. In clinical teaching in TCM neurology, students can assume the roles of patients, physicians, and family members in simulated rehabilitation consultations for patients with post-stroke sequelae. These exercises closely reproduce the processes of doctor-patient communication and syndrome differentiation and treatment in clinical practice. For example, a student playing the physician must analyze the simulated patient's symptoms, such as hemiplegia and impaired speech, in conjunction with tongue and pulse findings before developing an individualized rehabilitation plan. Meanwhile, a student playing a family member must accurately describe practical problems encountered during home care, such as the patient's emotional disturbances. This immersive training not only reinforces students' clinical reasoning based on TCM syndrome differentiation but also substantially improves their clinical communication skills. Existing research has shown that residents who undergo systematic role-playing training demonstrate sustained improvements in their ability to provide smoking cessation counseling one year after completing the training,

indicating that the benefits of this teaching approach can persist over time [21]. Role-playing also encourages students to empathize with patients and understand their psychological states. For example, patients frequently experience depressive symptoms following a stroke. During simulated consultations, students may therefore incorporate emotional regulation into their syndrome differentiation and treatment plans, avoiding the clinical pitfall of focusing exclusively on physical symptoms.

Instructor-led synthesis and review constitute a crucial step in consolidating learning outcomes. After group discussions and simulated clinical exercises, instructors should systematically summarize the fundamental principles of TCM clinical reasoning. For example, the holistic approach recognizes that the development of post-stroke sequelae is associated with interconnected factors, including dysfunction of the zang-fu organs and disturbances in the circulation of qi and blood. Syndrome differentiation and treatment, in turn, require medication regimens to be adjusted according to each patient's individual characteristics. Instructors should also explicitly identify common cognitive biases in clinical practice, such as overlooking the role of emotional factors in the onset and progression of neurological conditions. According to TCM theory, internal injury caused by the seven emotions can directly contribute to neurological disorders. For instance, anger may injure the liver, while excessive thinking may impair the spleen, potentially disrupting the normal ascending and descending movements of qi and aggravating post-stroke sequelae. By analyzing specific clinical cases, instructors can help students recognize that focusing solely on physical rehabilitation while neglecting emotional regulation may adversely affect treatment outcomes. Such reviews not only consolidate students' understanding of syndrome differentiation but also correct cognitive biases, enabling them to adopt a more systematic approach to clinical decision-making.

4. Application outcomes of the CBS-RISE teaching model in clinical teaching in TCM neurology

4.1. Improvement in students' clinical reasoning skills in traditional chinese medicine

The CBS-RISE teaching model integrates case analysis with independent inquiry using learning resources, effectively strengthening the practical application of clinical reasoning skills among students undertaking clinical placements in TCM neurology. When encountering complex conditions such as stroke and dementia during clinical teaching, students can apply core TCM approaches to syndrome differentiation, including zang-fu organ differentiation and meridian differentiation, more flexibly to analyze disease pathogenesis, reducing their reliance on mechanical memorization of isolated facts. For example, through step-by-step guidance using representative clinical cases, students can gradually develop a complete clinical reasoning sequence of "symptoms–syndrome differentiation–treatment method–prescription". This process further reinforces the role of TCM theory in guiding clinical diagnosis and treatment decisions [22]. Existing research has shown that case-based learning in TCM clinical education can effectively improve students' practical skills and overall competence, with particularly notable advantages over traditional didactic teaching in developing clinical reasoning abilities [23]. In clinical teaching in TCM neurology, students' accuracy in syndrome differentiation has improved significantly after participating in discussions of complex cases, such as dementia accompanied by depression. This outcome is closely associated with the CBS-RISE model, which encourages students to actively consult classical TCM literature and deepen their understanding of the historical development of academic thought in TCM neurology. For example, it helps students better understand how Li Dongyuan's academic principle that "internal injury to the spleen and stomach gives rise to all kinds of diseases" applies to the pathogenesis of neurological conditions. The model can also strengthen students' motivation for

independent learning. More frequent literature searches help students identify clinical reasoning approaches in classical medical texts and establish a more systematic framework for clinical reasoning in TCM [24]. Implementing this teaching approach not only deepens students' understanding of TCM theory but also improves their ability to translate theoretical knowledge into clinical practice, providing strong support for the development of highly qualified future specialists in TCM neurology.

4.2. Promotion of students' independent learning and collaborative skills

Applying a resource-oriented learning model to the teaching of TCM neurology can substantially improve students' ability to independently retrieve, evaluate, screen, and synthesize information. By guiding students to actively consult recent research findings, such as clinical diagnosis and treatment protocols for stroke rehabilitation published in recent years, instructors can help students independently update and refine their knowledge frameworks. This approach overcomes the limitations of traditional teaching, which relies on the one-way transmission of knowledge by instructors, and gradually fosters active learning habits. This problem-oriented inquiry process not only strengthens students' information literacy but also enables them to apply evidence-based medicine more flexibly to support clinical decisions when managing complex cases. This approach is consistent with teaching strategies that improve clinical decision-making through group discussions [25]. Integrating group discussions, role-playing, and other activities into the teaching process can strengthen students' awareness of teamwork. During simulated case management, students must coordinate their efforts and assume clearly defined responsibilities. For example, one student may be assigned to collect information through the four diagnostic methods of TCM, while another is responsible for verifying and organizing relevant literature. Such role allocation effectively reproduces multidisciplinary collaboration in real clinical settings. Existing research has confirmed that role-playing and group assignments help students better understand the importance of team communication and the allocation of responsibilities, thereby improving overall collaborative effectiveness [26]. Feedback from students indicates that this teaching model substantially stimulates their interest in learning and alleviates the sense of disengagement associated with passively receiving information under traditional clinical teaching approaches. Through active participation in discussions and simulated clinical exercises, students move beyond the role of passive recipients of knowledge and become active knowledge seekers. This shift not only increases overall classroom participation but also strengthens their confidence in addressing practical clinical problems. During group discussions, students can develop a better understanding of the logic underlying syndrome differentiation in TCM neurology by presenting their own perspectives and exchanging ideas. This finding is consistent with previous research demonstrating that interactive learning promotes the deeper internalization of knowledge [27]. Overall, the deep integration of resource-oriented learning and collaborative teaching methods offers an effective and innovative approach to teaching practice in TCM neurology. It has a clear positive effect on cultivating TCM professionals who possess both independent inquiry skills and strong collaborative abilities.

4.3. Effects on clinical teaching quality and teaching efficiency

The implementation of case-based teaching has brought about a fundamental shift in the role of instructors, transforming them from traditional providers of knowledge into facilitators and supporters of learning activities. This shift allows instructors to devote more attention to correcting students' clinical reasoning. For example, when teaching syndrome differentiation and treatment in TCM, instructors can promptly correct the rigid tendency to select a prescription first and then fit the patient's syndrome to it, thereby improving the precision and depth of clinical instruction [28]. Existing research indicates that, in CBL settings, guiding

students through the analysis of actual clinical cases is more effective in developing their clinical reasoning and logical thinking skills than delivering knowledge through lectures alone [29].

A structured teaching model centered on clinical cases can help avoid the subjectivity and arbitrariness sometimes encountered in traditional teaching. A standardized case database organized according to clinical disease categories enables teaching content to be systematically divided into standardized units and integrated into modules. This facilitates the assessment and evaluation of teaching outcomes and supports ongoing optimization, while ensuring the systematic and coherent delivery of knowledge [30]. For example, in anatomy teaching, students in the experimental group taught using the CBL approach achieved significantly better scores on knowledge-retention tests than students in the control group who received traditional didactic instruction. The mean score difference in the experimental group was 0.122 ± 1.05, compared with 0.016 ± 0.95 in the control group. These findings demonstrate the positive effect of structured case-based teaching on long-term knowledge retention [17].

The CBL model incorporates staged student presentations and immediate feedback mechanisms, providing instructors with practical information for dynamically adjusting the pace of teaching. Based on students' actual levels of mastery in key areas, such as identifying difficulties in syndrome differentiation and establishing diagnostic reasoning, instructors can flexibly extend focused discussions or adjust the emphasis of different teaching stages [31], thereby improving overall teaching effectiveness. A controlled study involving nursing students found that the class taught using CBL achieved higher final examination scores than the class receiving traditional instruction, directly demonstrating the potential advantages of CBL in improving teaching efficiency [32]. Students surveyed also generally reported that CBL helped them integrate theoretical knowledge with practical clinical skills more effectively. Specifically, 96% of students explicitly indicated that this teaching method had a positive effect on the practical application of their knowledge of clinical pharmacology [33].

5. Directions for optimizing the CBS-RISE teaching model in clinical teaching in TCM neurology

5.1. Continuous development and updating of the case database

In the practical application of the CBS-RISE teaching model, the quality of the case database and its dynamic updating are key factors influencing teaching outcomes. During clinical teaching in TCM neurology, instructors should regularly compile and organize cases encountered in actual clinical practice, particularly those involving relatively rare neurological conditions, such as Wilson's disease (hepatolenticular degeneration). These cases should then undergo standardized processing [34] to transform them into suitable teaching materials, ensuring that the case database remains current and covers a wide range of diseases. A case database built on authentic clinical data can realistically reproduce actual clinical encounters, expose students to a greater variety of disease types, and substantially strengthen their ability to manage practical clinical problems. Case development should fully reflect the distinctive characteristics of TCM diagnosis and treatment. For example, when analyzing the pathogenesis of neurological conditions, instructors can incorporate the theory of the Five Circuits and Six Qi to examine how changes in climatic and seasonal patterns may influence disease onset and progression. Potential errors in syndrome differentiation should also be clearly identified, such as the key distinctions between *wind and fire mutually intensifying each other* and *phlegm-heat accumulation with bowel excess*. These measures can help students gradually develop clinical reasoning skills in TCM [35] and deepen their understanding of complex disease mechanisms. To

accommodate the learning needs of students at different academic levels, a graded case-difficulty system should also be established. For undergraduates, introductory cases involving common diseases and typical syndromes may be prioritized. Postgraduate students, by contrast, should be provided with advanced cases involving rare diseases, difficult-to-differentiate syndromes, and multisystem comorbidities. This approach helps prevent mismatches between case difficulty and students' abilities while ensuring that teaching content is appropriate to their current level and provides sufficient intellectual challenge [34]. Through sustained refinement and dynamic updating, the case database can serve not only as a resource for routine teaching but also as a reliable platform for independent learning and clinical reasoning practice, thereby contributing to the steady improvement of clinical teaching quality in TCM neurology.

5.2. Resource integration and technical support

Improving the quality of teaching in TCM neurology requires close coordination between the integration of teaching resources and the support provided by information technology. The first step is to establish a dedicated teaching resource database for TCM neurology by categorizing and integrating classical medical texts from different historical periods, contemporary research findings, and clinical imaging materials. This would provide students with convenient access to resources through a unified search interface. For example, the database could include discussions of the pathogenesis and treatment principles of stroke and manic-depressive disorders from classical texts such as *Shanghan Lun* (*Treatise on Cold Damage*) and *Wenbing Tiaobian* (*Systematic Differentiation of Warm Diseases*). It could also incorporate modern pharmacological research findings, including evidence that the Chuanxiong–Xiangfu herb pair intervenes in qi stagnation and blood stasis syndromes through a "multiple components–multiple targets" mechanism [36], as well as studies combining Ultra-Performance Liquid Chromatography (UPLC) fingerprinting with chemometric pattern recognition to analyze Angong Niuhuang Wan [37]. These resources would enable students to directly compare the historical development of TCM understanding of neurological conditions with contemporary scientific findings. Meanwhile, virtual simulation teaching systems could be introduced to dynamically reproduce changes in the tongue and pulse manifestations of patients with stroke. For example, three-dimensional visualization models could demonstrate the progression of tongue coating from thin and white to yellow and greasy, enhancing the immersive and interactive qualities of clinical cases and helping students understand the temporal and dynamic characteristics of syndrome differentiation in TCM. Online communication platforms could also expand classroom discussions beyond scheduled teaching sessions, encouraging students to discuss challenging questions after class. For example, discussions on the value of changes in tongue coating in assessing stroke prognosis could incorporate the scholarly perspective emphasizing the clinical significance of tongue diagnosis in *Ganzheng Jingyi Yuebian* [38]. These discussions could also draw on research into the mechanisms by which TCM herbal ointments alleviate inflammatory pain through modulation of the ERK1/2–COX-2–PGE2 signaling pathway [39]. This would encourage students to analyze clinical problems from two complementary perspectives: the inheritance of classical TCM theory and the interpretation of modern biological mechanisms. The coordinated application of integrated resources and technological support can substantially improve teaching efficiency while helping students develop a deeper understanding of the complex theoretical frameworks underlying TCM neurology.

5.3. Improvement of the evaluation system

Establishing a scientific and comprehensive multidimensional assessment and evaluation system is essential to ensuring teaching quality during the implementation of case-based teaching. Traditional evaluation methods tend to focus exclusively on the correctness of final answers, paying insufficient attention to the development

of students' core competencies throughout the learning process. It is therefore necessary to establish evaluation criteria covering multiple dimensions, including the rigor of case-based reasoning, the appropriateness of learning resource utilization, and the demonstration of critical thinking during discussions, thereby enabling a comprehensive assessment of students' overall competence [40]. For example, whether students can propose innovative approaches to syndrome differentiation during group discussions can serve as a key indicator of their clinical reasoning development. Such a multidimensional evaluation model enables a more accurate assessment of students' actual abilities in knowledge transfer and application, practical problem-solving, and teamwork [41].

To stimulate students' enthusiasm for participation and encourage active reflection on their learning, multiple evaluation mechanisms, including student self-assessment and peer assessment, can be introduced. Students can evaluate the actual contributions made by their group members during discussions, such as whether they have proposed innovative approaches to syndrome differentiation. This process not only develops students' critical thinking skills but also strengthens their sense of individual responsibility and awareness of collective collaboration [40]. Through self-assessment and peer assessment, students can review their entire learning process from multiple perspectives, gain a clearer understanding of their strengths and weaknesses, and promote deeper engagement in learning activities.

Instructors should also regularly compile and analyze feedback collected throughout the teaching process and dynamically adjust case difficulty levels and the selection of supporting learning resources in light of students' classroom performance and course evaluation results. A closed-loop management mechanism consisting of "instructional design–implementation–outcome evaluation–iterative optimization" can effectively ensure the continuous refinement of teaching content and the steady improvement of teaching outcomes [42]. For example, instructors can adjust the complexity of subsequent cases according to students' logical reasoning abilities and their use of various resources during case analysis. They can also provide targeted resources addressing students' specific learning weaknesses, thereby establishing a positive feedback loop between teaching and learning and promoting the continuous, progressive improvement of course quality.

6. Conclusion

The integrated CBS-RISE teaching model has significant practical value in clinical teaching in TCM neurology. By deeply integrating case-based teaching with resource-integrated learning, the model can effectively strengthen interns' clinical reasoning based on TCM syndrome differentiation and their motivation for independent learning. Its instructional process begins with authentic diagnostic and treatment scenarios or highly realistic clinical cases involving neurological conditions [16]. Students are guided to conduct systematic reasoning through the entire process of syndrome differentiation, treatment principles, therapeutic methods, and prescription selection based on key information from the cases. They are also encouraged to independently search relevant academic literature, thereby deepening their understanding of classical TCM theories and advances in modern clinical medicine and ultimately establishing a comprehensive learning pathway that connects theoretical knowledge with clinical practice. This learner-centered teaching approach not only fully stimulates interns' initiative in learning but also specifically develops their overall ability to independently assess and manage practical clinical problems. It is therefore well suited to the complex range of diseases and the highly variable clinical presentations encountered in TCM neurology.

Nevertheless, the practical implementation of this model also presents several challenges. First, the development of teaching cases must accommodate both the distinctive characteristics of TCM and the requirements of modern medicine. Cases must reflect the fundamental principles of syndrome differentiation

and treatment in TCM while incorporating standardized diagnostic and treatment procedures in modern medicine. This places higher demands on instructors' interdisciplinary expertise and instructional design skills. Second, instructors must transition from their traditional role as transmitters of knowledge to that of facilitators and supporters of student learning. This role transition requires systematic training and sustained teaching experience to ensure that instructors can effectively guide students in case analysis and literature review. In addition, the coordinated integration and dynamic updating of teaching resources, as well as variations in students' independent learning abilities, are practical issues that require particular attention during implementation.

Looking ahead, the CBS-RISE teaching model has considerable potential for application in TCM education. First, it could gradually be extended to other TCM specialties, such as acupuncture and pediatrics, with cases tailored to the clinical characteristics of each specialty and designed to develop clinical reasoning skills aligned with its specific diagnostic and treatment requirements. Second, artificial intelligence technologies could be introduced to further enhance the model. For example, an intelligent case-generation system could automatically generate diverse cases according to predefined teaching objectives and students' actual learning levels, while providing relevant literature resources and real-time learning feedback. This would enable dynamic optimization of teaching pathways and substantially improve overall teaching efficiency. Through continued practical exploration, refinement, and innovation, the CBS-RISE teaching model is expected to become an important reference framework for clinical teaching in TCM, providing strong support for the cultivation of highly qualified professionals in traditional Chinese medicine and pharmacy.

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