



# Application of CTTM and SECI in Critical Care Medicine Teaching Based on the Concept of Results-oriented Education

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DOI: 10.32629/jcmr.v5i1.1773

**Abstract:** In the context of rapid social development, frequent disasters and major accidents pose challenges to the comprehensive abilities of critical care medicine professionals. As an emerging interdisciplinary discipline, critical care medicine encompasses a wide range of professional knowledge. Therefore, emphasizing a results-oriented approach in teaching is crucial. This approach prioritizes teaching outcomes, focusing on enhancing students' abilities and achieving teaching objectives. Implementing the joint approach of CTTM and SECI for critical care medicine teaching proves to be a potent method for realizing the results-oriented education concept. This paper explores the connotations of CTTM and SECI teaching models and their application in the interdisciplinary integrated teaching of critical care medicine. Additionally, it discusses their collaborative use in critical care medicine education, aligning with the principles of results-oriented education for future reference.

**Keywords:** results-oriented, CTTM, SECI, critical care medicine, interdisciplinary integration, teaching

## 1. Introduction

Critical care medicine is a comprehensive discipline focused on understanding the occurrence and development of emergency, severe, and critical diseases. It provides essential organ function support and advanced life-saving interventions, serving as the ultimate "defense line" in disease treatment and playing a crucial role in hospital settings. Particularly noteworthy is its pivotal role in addressing major public health events, gaining increased recognition and support from national and local governments, leading to rapid development.

However, the intricate nature of severe diseases, characterized by urgency, danger, and severity, makes their treatment challenging. The demand for medical students to master clinical thinking, skills, and theories is exceptionally high. The current shortage of critical care medicine professionals is a pressing issue, emphasizing the urgency of enhancing the teaching quality in this field.

In recent years, the results-oriented concept, focusing on teaching outcomes and prioritizing the improvement of students' abilities, has gained widespread acceptance. However, implementing this concept in critical care medicine education requires exploring suitable teaching modes. The CTTM model, rooted in information technology and incorporating case teaching, and the SECI model, based on explicit and implicit knowledge with an emphasis on practical teaching, provide promising avenues. Integrating these models in critical care medicine education enhances the multidisciplinary clinical thinking, theoretical learning, and practical abilities of students, as observed in teaching practices.

## 2. Analysis of the status quo of critical care medicine teaching

In recent years, China has intensified its efforts to innovate medical education, emphasizing the core role of "new medical science." This initiative aims to optimize the professional structure of medical disciplines by constructing new medical-related majors and fostering deep cross-integration with multiple disciplines. Medicine inherently integrates principles from various fields such as natural sciences, technical sciences, social sciences, and humanities.

Critical care medicine, a specialized field focusing on the rescue, monitoring, and treatment of critically ill patients, aims to deliver highly specialized medical care to save lives, improve survival rates, and enhance rehabilitation. The rapidly evolving knowledge in critical care medicine, coupled with the high-pressure environment of clinical medical work, has propelled postgraduate education in China into a new stage of rapid development. The training system has become a focal point for research in various medical institutions and specialized teams. However, the industry faces challenges, particularly in navigating the career stage during the continuous training of medical talents. Establishing an efficient and high-quality composite talent training system for critical medicine is both urgent and crucial. Currently, China's intensive

critical medicine talent training model falls short of meeting the demands of the new economic development model for talent supply, highlighting a growing contradiction between the traditional curriculum system and the evolving professional quality requirements of clinical medicine graduate students.

Critical care medicine, as a comprehensive discipline, necessitates the integration of knowledge and skills from medicine, nursing, pharmacy, engineering, and other disciplines for effective cross-application. Teamwork, integrating diverse specialties' expertise and perspectives, plays a pivotal role in providing comprehensive treatment to meet patients' multifaceted needs. The evolving trend in critical care medicine is towards individualized, integrated, and evidence-driven approaches. With increasing emphasis on multidisciplinary collaboration and cooperation, paramedical staff in each specialty contribute significantly to the rescue and treatment process by providing professional services and support. In terms of training and professional development, critical medicine is increasingly focusing on the training and certification of paramedical staff to ensure they possess the necessary knowledge and skills.

The development of critical care medicine is evolving towards specialization, encompassing individual intensive care units (ICUs) such as surgical ICU, pediatric ICU, neurological ICU, external thoracic ICU, and internal medicine ICU. As a nascent specialty, critical care medicine faces limited sources of graduate students, most of whom transition to this field after graduating from other specialties. Using the Department of Critical Care Medicine at West China Hospital of Sichuan University as an example, an investigation into the professional background of graduate students revealed diverse origins, including internal medicine (43%), surgery (40%), anesthesiology (15), and pediatrics (2%). However, the existing training system does not align with the current development of critical care medicine, fails to adapt to the pace of progress, and hinders the conducive evolution of the specialty.

### **3. Introduction of CTTM and SECI teaching methods**

#### **3.1 CTTM teaching method**

Case-based three-dimensional teaching method, also known as the "CTTM" teaching method, is a new teaching method relying on case teaching and three-dimensional teaching. With the knowledge of information technology and the integration of case teaching method, teachers can use artificial intelligence, information networks, medical imaging, and other technologies to assist the implementation of the CTTM teaching method, give full play to the advantages of information teaching, and present knowledge content from multiple perspectives. In the teaching process of critical care medicine, the introduction of the CTTM teaching method allows teachers to design teaching plans using teaching videos, multimedia, audio-visual teaching, and high-quality online courses, present "virtual patients" and clinical case data and information in a three-dimensional way, demonstrate professional knowledge, mobilize students' enthusiasm for learning, and create clinical practical operation situations through simulation technology. The critical care medicine teaching process is presented in a three-dimensional way, showing the systematic and multi-angle characteristics of the teaching process.

#### **3.2 SECI teaching method**

SECI teaching mode believes that the process of knowledge creation requires learners to have a dynamic understanding of knowledge. By applying this teaching mode, knowledge can be divided into explicit knowledge and implicit knowledge. Explicit knowledge can be learned through language explanation, which has normative and systematic characteristics. Tacit knowledge and explicit knowledge, in contrast, belong to the content learned by intention, can not be learned in a normative way, and pay more attention to the transmission of experience. In critical care medicine teaching, explicit knowledge is mostly explained, while tacit knowledge is ignored, which affects the improvement of students' comprehensive ability. The professional teaching process has the characteristics of multiple, not only the need to transfer explicit and implicit knowledge but also the need to let students feel the application process of knowledge through practical operation, and pay attention to the cultivation of students' practical ability.

Based on the results-oriented concept, teachers can use case teaching, enlightening teaching, information teaching, and other methods to create learning scenarios for students and stimulate their learning potential. Therefore, the feasibility of integrating the SECI teaching mode and CTTM teaching method is relatively high.

### **4. The application strategy of CTTM and SECI in critical care medicine based on the results-oriented concept**

#### **4.1 The application of the combined teaching method to explain the theory of critical care medicine**

Based on the results-oriented concept, the teaching of critical care medicine should take professional knowledge

and emergency, critical disease, and critical care treatment techniques as the ultimate teaching purpose, to cultivate more comprehensive medical talents. In the selection of teaching mode, it is necessary to pay attention to the integration of multiple disciplines, break the barriers between professional disciplines, integrate the knowledge between critical care medicine and pathology, rehabilitation medicine, pharmacy, and oncology, apply the CTTM teaching mode, present comprehensive cases in three aspects, and achieve the teaching effect of "1+1 > 2". At the same time, under the application of the SECI model, the explicit and tacit knowledge from other disciplines will be introduced into the critical care medicine classroom to create a disciplinary integration learning scene for students and give play to CTTM learning from disease prevention, diagnosis and treatment.

The application of the SECI teaching method has the characteristics of socialization, that is, the transformation process of tacit knowledge in critical care medicine into explicit knowledge. It is necessary to establish a scene for students to observe and practice, and students can complete the transformation of knowledge through experience sharing. In this process, the guidance role of teachers is very important. Teachers can show typical cases or share knowledge-learning experiences for students in conjunction with the CTTM teaching method so that students can master common knowledge and skills [1]. The first stage of knowledge transformation, is also the process for students to accumulate and transfer tacit knowledge. Teachers can give full play to the advantages of information technology, give consideration to the explanation of explicit knowledge and tacit knowledge, take the development of students' comprehensive ability as the guidance, use the way of multidisciplinary integration, present the theoretical knowledge of critical care medicine, externalize professional knowledge, and complete the transformation of tacit knowledge to explicit knowledge. During this period, the transformation methods of critical care medicine professional knowledge include model concepts, metaphor and analogy, etc. According to the teaching resources presented by teachers, combined with their knowledge and experience, students give play to imagination and creativity to transform professional knowledge into content that can be described in language and share knowledge among students. Therefore, the application of the joint teaching model is also the process of transforming perceptual knowledge into rational understanding. The professional knowledge will be externalized to promote the growth of students' overall knowledge.

In the teaching process, teachers should dig deep into the learning potential of all students, create a good teaching atmosphere through the innovation of teaching methods, and encourage students to transform their tacit knowledge into explicit knowledge. In the theoretical teaching process of critical care medicine, relying on the CTTM teaching method, teachers take students as the main body, fully consider the needs of students, carefully select typical cases in the field of critical care medicine, use information technology to design teaching plans, make teaching courseware and videos, show the interdisciplinary characteristics of teaching content, mobilize students' interest in learning theoretical knowledge, and achieve joint teaching goals. At the same time, teachers can also choose typical clinical cases, establish the SECI model, assist students to transform tacit knowledge, consolidate and review in time, and connect professional theory and practice teaching process. In addition, the application of the joint teaching model advocates group cooperation and knowledge sharing and establishes a learning community between teachers and students to promote knowledge externalization. Under the application of the joint teaching model, for difficult clinical problems, teachers can organize joint discussions among students, guide them to use the Internet to search for literature information related to complicated diseases and cultivate their spirit of exploration.

#### **4.2 Create a teaching situation by applying a joint teaching method**

SECI teaching mode has the characteristics of a combination, that is, the combination of explicit knowledge and tacit knowledge. In the teaching process of critical care medicine, teachers should effectively present theoretical knowledge. Relying on the SECI model, symbolic language can be displayed through digital media to promote the combination of explicit concepts and present [2] them in a systematic way. Teachers create information-teaching situations for students, assist students integrating tacit knowledge, and exchange and recreate knowledge through mutual communication. During this period, the essence of knowledge transfer is to edit the group's explicit knowledge, transform it into organizational explicit knowledge, and spread and apply it within the organization. Under the application of the results-oriented concept, teachers combine the CTTM teaching mode, give full play to the advantages of information technology application, create a real learning scene for students to learn critical medicine knowledge, build a learning platform, establish a knowledge diffusion collaborative system among students, publish specific information on the network platform, ensure the effective transfer of professional knowledge, and communicate with each other among students. Participate in exchange activities under the support of the network platform, provide students with opportunities to integrate knowledge, and make the process of knowledge diffusion and update more efficient and convenient.

### 4.3 Applying joint teaching to train clinical skills

Under the SECI teaching mode, the internalization process is the transformation of explicit knowledge into implicit knowledge, and it is also the process of embodiments and visualizations of explicit knowledge. Students digest and absorb what they have learned through knowledge summary and internalize it into their implicit knowledge. At this stage, students broaden their thinking and apply knowledge into practice through the sharing method within the learning group. In this regard, teachers are required to create practical application scenarios for students in the teaching process. In addition to the necessary theoretical knowledge, critical care medicine requires students to master a variety of emergency methods, such as tracheal intubation, deep vein catheterization, cardiopulmonary resuscitation, and ventilator adjustment skills. Combined with the CTTM teaching mode, teachers can use simulation situations, organize students to participate in practice exercises, set disease models, ask students to use practical skills, and finally give practical feedback through the computer system. Such as the application of virtual experiments or virtual communities, setting practical tasks for students, and exercising students' practical ability [3].

### 4.4 Applying the combined teaching method to carry out interdisciplinary integrated teaching

The so-called interdisciplinary integrated teaching (also known as STEM) is a comprehensive and practical teaching model that covers mathematics, engineering, technology, and science. It aims to cultivate students' ability to teamwork, innovation, and problem-solving. This teaching mode has similarities with the combined teaching method, and the teaching goal is consistent. In the teaching process of critical care medicine, teachers can also combine CTTM, SECI, and other teaching methods with interdisciplinary integration teaching mode, introduce scientific field knowledge, assist in the explanation of critical care theoretical knowledge, use cases in the medical engineering field, show the application advantages of CTTM teaching mode, and use information technology to create three-dimensional learning scenes. Show the application characteristics of interdisciplinary integrated teaching mode, so that students can learn more field knowledge in the classroom, and enhance the interest of the teaching of critical medicine professional knowledge. Under the guidance of teachers, students can try to use techniques or knowledge in other fields to think and solve problems and improve their thinking and problem-solving abilities. Because STEM is the demand of the future development of the industry, the application of interdisciplinary integrated teaching from the perspective of the training of critical care medical professionals will promote the improvement of the comprehensive competitive strength of talents. In addition, the STEM teaching mode also has the characteristics of practicality, which is consistent with the teaching objectives of SECI. In the critical medicine class, teachers assign practical tasks to students, stimulate their enthusiasm for learning knowledge in the fields of medicine, technology, science, and engineering, and improve the technical level of medical posts.

## 5. Conclusion

In conclusion, within the realm of critical care medicine education, a result-oriented integration of models like CTTM, SECI, and others, coupled with the incorporation of an interdisciplinary integrated teaching model, can effectively balance the development of students' theoretical knowledge and clinical skills. This approach genuinely realizes a student-centric focus, aligning teaching goals with industry development needs, and fostering innovation in the intensive care medicine teaching paradigm. The ultimate aim is to produce a greater number of high-quality medical professionals, achieve comprehensive teaching objectives, enhance students' understanding of critical medicine theory, nurture a culture of critical clinical thinking, and refine their practical skills for the workplace.

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