

Exploring a case-based guided training model for standardized education of clinical pharmacists addressing national talent shortages

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Abstract: *The standardized training of clinical pharmacists, who are urgently needed at the national level, is attended by many participants from grassroots hospitals. The focus of their training is on developing the ability to solve practical problems, emphasizing the cultivation of comprehensive abilities for general pharmacists. Utilizing a case-oriented teaching model, which is guided by typical cases, deepens learning methods and enhances the cultivation of comprehensive qualities through the systematic analysis of case processes. This approach not only considers the students' foundations but also stimulates their subjectivity and enthusiasm. It is a teaching model centered on clinical medication practice, capable of cultivating clinical pharmacists for grassroots hospitals who can effectively address clinical issues.*

Keywords: *Clinical pharmacist; Standardized training; Teaching model*

1. Introduction

In recent years, the national initiative has been to increase efforts in the training of medical professionals in critical and urgently needed fields^[1]. To adapt to the new trends in national healthcare reform and the evolving requirements of clinical pharmacy, accelerate the transformation of pharmaceutical service models, enhance the level of pharmaceutical management in grassroots hospitals, strengthen the construction of clinical pharmacist teams at the grassroots level, and improve the clinical pharmacy service system, the National Health Commission added the Clinical Pharmacist Training Program to the training projects for scarce talents in health sector in 2019. Our institution was selected by the Shaanxi Provincial Health Commission as the training base for clinical pharmacy in accordance with national requirements. The standardized training of clinical pharmacists as urgently needed talents at the national level focuses on meeting the training needs of clinical pharmacists in medical institutions, prioritizing participants from grassroots and impoverished areas within the jurisdiction. The cultivation of the ability to solve practical problems is particularly important. For grassroots hospitals, the shortage of clinical pharmacist personnel and the lack of qualified clinical pharmacists are significant challenges that deviate far from practical requirements. A professional training model for clinical pharmacists in grassroots hospitals has not been established in China. Participating in standardized training for clinical pharmacists is one of the fastest ways to address the shortage of clinical pharmacists and the incomplete knowledge structure at the grassroots level.

In the teaching process at our institution, we have observed that exploring typical cases from clinical practice, which are meaningful for teaching, and further investigating and discussing them can significantly guide the clinical thinking of students and enhance the competence of clinical pharmacists. Based on this approach, we have developed a teaching model for such students, and the following is a discussion of this teaching model based on our institutional experience.

2. Exploration of preceptorship models

2.1 Cultivating the ability to summarize key medical history points along a temporal axis

2.1.1 Sequentially summarizing the onset process and relevant symptoms over time

Targeted training encourages students to organize case data, guiding them to integrate time and changes in symptoms when summarizing medical records. Emphasis is placed on the progression of the patient's condition and practical problems that need urgent resolution

Illustrative Case: A 67-year-old male patient complained of cough and sputum for a month upon admission. The diagnosis revealed right lower lobe lung cancer. After undergoing general anesthesia for a right lower lobe resection, the patient experienced recurrent fever, with a maximum temperature of 39.0°C, and an increase in yellow purulent sputum. Amikacin, used for anti-infective treatment, showed poor efficacy. The primary clinical problem to be addressed is adjusting the antimicrobial drug regimen.

2.1.2 Systematically organizing case-related examination indicators and medication history

Guiding students to systematically organize relevant examination indicators and medication history in a simple and intuitive form, such as tables and charts, facilitates the clear analysis of the trend of changes in the patient's condition.

2.2 Cultivating analytical thinking for clinical problems and key problem analysis skills

2.2.1 Extracting clinical issue analysis from the original treatment plan

Combining the disease course, the original treatment plan, and examination indicators, guide students to analyze the reasons for the unsatisfactory treatment effect of the original plan.

Case Guidance: The inadequate treatment of this patient may be due to the unreasonable use of amikacin as a single antimicrobial therapy. Aminoglycosides, such as amikacin, achieve concentrations in sputum that are approximately 10-40% of blood concentrations. However, factors in purulent sputum, such as calcium, magnesium ions, acidic conditions, and anaerobic environments, often affect the antimicrobial activity of aminoglycosides. Their efficacy is often compromised when used alone^[2].

2.2.2 Providing rational suggestions for key steps

Guiding learners to integrate relevant theories with clinical symptoms, thereby cultivating the ability to identify key steps in real-world problems based on case information.

Case Guidance: The patient has been experiencing prolonged postoperative fever, with a consistent drainage volume of 100ml or more daily. Despite multiple negative sputum smear and culture results and ineffective empirical treatments with various antimicrobial agents, the primary concern now revolves around obtaining valuable bacterial culture results. Fiberoptic bronchoscopy alveolar lavage, as an innovative sampling technique, presents increased opportunities for pathogen retrieval with a lower probability of contamination, establishing itself as a reliable method for diagnosing pneumonia pathogens^[3]. It is recommended that the patient undergo fiberoptic bronchoscopy alveolar lavage concurrently with relevant cultures for a more targeted and accurate diagnosis.

2.2.3 Cultivating independent proficiency in developing appropriate treatment plans

The ultimate focus of training clinical pharmacists, considered as urgently needed talents in the country, is on solving practical issues. Therefore, it is crucial to emphasize the cultivation of students' ability to independently analyze existing information, think critically about strategies, and propose rational treatment plans.

Case Guidance: The empirical drug selection for this patient is as follows: ① The patient has recurrent fever of 39°C, elevated blood count, cough with yellow sputum, and a G- lipopolysaccharide level of 26.83 pg/ml, indicating a high possibility of G- bacterial infection. ② The patient has a history of surgery with a long operation time, a 20 cm incision, two large lesions, and the current elevation in blood count with increased yellow drainage. MRSA has not been covered in the medication history, so the possibility of MRSA infection should be considered. ③ Only a moderate amount of Candida was found in one sputum culture, G test was negative, no white patches on the oral mucosa, and a cough with a large amount of yellow sputum. Therefore, Candida infection is temporarily not

considered, and it is recommended to re-examine sputum for bacterial and fungal smear cultures. Based on the patient's past medication history, surgical history, body temperature, blood count, PCT, sputum color, and sputum smear results, it is inferred that the patient may have a mixed infection of G- and G+ bacteria. The analysis also indicates inappropriate drug selection and inadequate dosage in the previous treatment. Therefore, it is recommended to switch to vancomycin to cover MRSA^[4].

2.3 Cultivating clinical practice skills to flexibly transform clinical thinking based on changes in patient conditions

2.3.1 Cultivating the habit of formulating pharmaceutical care plans

In developing the habit of creating pharmaceutical care plans, particularly for patients requiring intensive monitoring, students can be guided to establish feasible monitoring elements based on the patient's foundational conditions and the progression of the illness. This approach serves as a dynamic adjustment axis for medication plans, facilitating a clear delineation of changes. Simultaneously, it aids in organizing clinical thinking and provides direction for the subsequent treatment plan.

2.3.2 Cultivating the ability to integrate clinical thinking and pharmaceutical perspectives for medication selection

In guiding learners through training and learning to enhance their professional competence, it is essential not only to have a solid foundation in basic theory but also to thoroughly analyze the differences and advantages of various medication plans. Learners should dynamically adjust the most suitable medication plan based on clinical changes.

Case Guidance: At this juncture, the patient's primary concern is rapid fever reduction. The measured vancomycin blood concentration is 7.5 µg/ml, indicating the need for a dosage increase to achieve therapeutic levels. However, with the patient already receiving 1g every 12 hours, further dose escalation poses a high risk of hepatic and renal impairment. Linezolid pulmonary epithelial lining fluid (ELF)/blood concentration is notably higher at 1.05 compared to vancomycin's 0.19^[5]. Moreover, linezolid significantly reduces the production of TNF-α, leading to a rapid decrease in body temperature^[6]. Linezolid's average fever-reducing time in treating MRSA is 3 days, and its therapeutic effect surpasses that of vancomycin^[7,8]. Therefore, optimizing the antimicrobial agent to linezolid is considered a viable option.

2.3.3 Cultivating the ability to simplify clinically complex problems

Train students to acknowledge the complexity of clinical problems, identify major contradictions, and prioritize solving key issues as the core therapeutic strategy. Factors that do not impact the overall diagnostic and treatment plan and have a low safety risk can be monitored appropriately with a lenient approach.

Guidance Example: In a patient with lavage fluid culture showing a small amount of *Pseudomonas aeruginosa*, whose peak body temperature has decreased compared to previous highs, fever duration has significantly shortened, sputum production has notably reduced, and procalcitonin (PCT) is 0.17ng/ml with a clear improvement from previous levels, considering *Pseudomonas aeruginosa* as colonizing bacteria, there is no need to adjust the current treatment plan. Ultimately, the patient's infection is well-controlled, and they are discharged in good condition.

2.4 Case reporting and discussion to deepen the analysis and summary of clinical practice

The analysis and sharing of case summaries are essential for refining and enhancing students' clinical practice capabilities. A comprehensive review of typical cases not only reflects on neglected clinical issues and summarizes successful experiences but also supplements domestic and international evidence-based medicine evidence, rapidly improving students' comprehensive abilities.

Case Summary: This case offers valuable insights: ①Crucial Role of Pathogenic Evidence: The pivotal factor for treatment success is the acquisition of clear pathogenic evidence. A thorough understanding of the pathogenic profile enhances treatment precision. ②Holistic Approach in Empirical Treatment: During empirical treatment, a comprehensive assessment, integrating patient symptoms, medical history, and laboratory findings, is imperative to deduce potential pathogens. Drug selection should prioritize agents covering likely pathogens. ③PK/PD-Guided Medication Selection: Post pathogenic evidence acquisition, drug selection should align with

Pharmacokinetics/Pharmacodynamics (PK/PD) principles to optimize therapeutic efficacy. ④Distinct Efficacy of Linezolid: Linezolid exhibits rapid fever reduction and shortened illness duration, especially in critically ill patients with MRSA infection. Consequently, opting for Linezolid is a potentially effective treatment strategy in suitable scenarios. ⑤Rational Analysis of Microbiological Culture Results: Following microbiological culture results, a reasoned analysis is essential to eliminate interference from colonizing bacteria, ensuring precise diagnosis and treatment decisions.

3. Discussion

3.1 Training for nationally scarce clinical pharmacists differs from that of other clinical pharmacists.

Firstly, the trainees for nationally scarce talent in clinical pharmacy mostly come from grassroots hospitals, with little to no prior experience as clinical pharmacists, and a lack of clinical awareness. Therefore, the training should focus on cultivating clinical thinking and learning methods. Starting with typical cases, this approach aligns the cultivation of thinking more closely with clinical practice. Simultaneously, by analyzing and dissecting cases, the integration of pharmaceutical theory with actual patient medication and clinical signs can deepen the learning and understanding of basic pharmaceutical knowledge. Secondly, the training for nationally scarce talent follows a comprehensive training model, with an emphasis on anti-infectives and secondary attention to chronic diseases. The training for this category of students emphasizes a breadth of knowledge over depth. By analyzing and dissecting typical cases, key knowledge points and learning methods can be applied to similar cases, providing an effective guiding approach for the overall development of students' capabilities. Additionally, different training models require different capabilities from trainees. Clinical pharmacists in grassroots hospitals have limited staffing, and the team-oriented clinical pharmacist model is not in line with job requirements. Therefore, the cultivation of independent thinking and clinical decision-making skills is crucial. Building on typical cases, presenting real-world clinical problems, guiding students to identify key contradictions, choosing appropriate solutions, and finally summarizing and analyzing contribute significantly to enhancing clinical practice capabilities.

3.2 Advantages of the normative training model for nationally scarce clinical pharmacists guided by typical cases.

Teaching and learning methods oriented around typical cases impart specific practical content, methods, and skills for students to engage in clinical pharmacy work. This approach gradually builds clinical pharmacy thinking. Compared to traditional teaching methods, the case-oriented teaching model enhances students' ability for active learning, problem-solving, and communication collaboration. It also strengthens the connection between theory and practice and fosters interdisciplinary connections, emphasizing the practicality of learning. The practical advantages of this teaching model are mainly reflected in the following three points: (1) Cultivating the ability of trainees to analyze and solve problems. Based on the issues involved in typical cases, trainees search literature and gather necessary examination and diagnostic information. After inductive analysis, they formulate preliminary case analysis materials. (2) Increasing the trainees' initiative and enthusiasm for learning, allowing them to combine their practical experience to propose additional issues for joint discussion, fully leveraging their participation. Under the guidance of these issues, they apply learned knowledge to solve real clinical problems, gradually fostering correct clinical thinking abilities. (3) This teaching model plays a role in enhancing interaction between teachers and students, role reversal, and mutual learning. The teaching instructors provide personalized training plans for trainees, conduct standardized training based on clinical practice, and trainees can more flexibly apply theoretical knowledge to the practice of clinical drug therapy.

In the later stages of training and teaching, higher demands are placed on the personal qualities and capabilities of the teaching instructors. Teaching instructors need to enhance their individual teaching abilities and professional competence through methods such as instructional design, teaching guidance, teaching control, and teaching reflection. This is crucial for addressing the increasingly challenging teaching tasks.

4. Conclusion

The cultivation of clinical pharmacists is a complex and iterative exploration. Different training approaches need to be tailored to the diverse needs of individual students. The case-oriented training model, which focuses on clinical drug use practices, represents a teaching approach where the effectiveness has been particularly prominent in the training of clinical pharmacists, especially those urgently needed at the national level. This model not only takes into consideration students' foundational knowledge but also ignites their subjectivity and proactiveness. Through the systematic analysis of case processes, it not only deepens learning methods but also nurtures the development of comprehensive qualities in students. This approach contributes to the cultivation of clinical pharmacists in grassroots hospitals who can effectively address real-world clinical challenges.

Based on the summary of 4 years of teaching experience and the exploration of teaching models, the mentoring teacher should play a pivotal role. They guide students in terms of learning direction, content, depth, and other dimensions, enabling students to clarify goals and improve efficiency during the training process. This ensures that students actively participate in clinically rational drug use within the framework of standardized training. As mentoring teachers, it is crucial to gradually explore and summarize experiences during practical application. Engaging in extensive experience exchange is also essential to identify a teaching model that suits the cultivation of clinical pharmacists at the grassroots level, making the training of urgently needed clinical pharmacists in our institution more systematic and standardized.

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