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Exploring the perceptions and barriers of nurses working in remote areas on tele-educational delivery of pharmacy knowledge in China: a qualitative research

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ABSTRACT

Objective

There are insufficient educational resources and opportunities available to nurses at county-level medical institutions in China to receive pharmacy knowledge education. Video conference pharmacy education (VCPE) has become a solution. However, few studies have explored the perceptions of nurses participating in VCPE. The study was aimed to explore the perceptions of nurses participating in VCPE at county-level medical institutions in remote areas in China. The barriers and suggestions to improve the VCPE were also assessed.

Methods

A qualitative research method was used to conduct two focus group interviews with a semi-structured interview guide being developed. Twenty-three nurses from county-level medical institutions in Henan Province participated in the interview in May 2019. The interviews were audio-recorded and transcribed verbatim.

Results

Four themes were extracted on VCPE from this qualitative study: 1) knowledge gains, 2) areas of improvements, 3) advantages, and 4) expectations and suggestions.

Conclusion

The results of this study indicate VCPE is a valuable tool to provide education to nurses working at remote area county-level institutions. The results contribute to improvements in future VCPE deliveries.

Strengths and limitations of this study

VCPE is built based on the telemedicine center located in central China, which gives full play to the resource advantages of higher-level medical institutions. In the contemporary development of information systems, it's a significant reference for the development of continuing education of nursing staff in poor and remote areas.

The present study is the first qualitative research in Mainland China to explore the experience and expectations of nurses participating in remote pharmacy knowledge training.

The research subjects only included nursing staff from two medical institutions in Henan Province, which has certain limitations. Future research can be extended to a wider sampling range.

Keywords

Tele-education; Pharmacy knowledge; Video-conference; Nurse; Remote areas; Qualitative research

INTRODUCTION

In China, clinical pharmacy services provided at institutional settings only started in the early 1990s[1]. Currently, the Chinese institutions are still facing the shortage of clinical pharmacists, and this is especially true at remote county-level medical institutions[2]. At these institutions, there is a lack of clinical pharmacy support to nurses[3]. Studies have indicated that nursing staff, working at these medical institutions, need to receive pharmacy training to care for patients[4]. Pharmacy training is generally related to 1) drug information, such as preparation, administration, and storage; 2) basic knowledge of pharmacotherapy, chronopharmacology, and pharmacokinetics; 3) ability to monitor drug efficacy and adverse drug reaction; and 4) appropriate drug use in pregnant patients, elderly patients, and pediatric patients[5]. However, due to the remote location, nurses are struggling to get educational resources and opportunities at the places they work. Traditionally, county-level nursing staff need to attend in-person classroom learning or conferences hosted at larger cities, requiring long distance travels[6]. This wastes time and money. With information

technology, tele-education based on a "video conference system" has been explored to solve this problem[7]. Compared with the traditional model, video conference training is efficient, saving both time and money[8]. Under this new model, close cooperation and alliance relationships between county-level and higher-level medical institutions can be established. With video conference learning, learners have the option to attend real-time or conduct home study through watching recorded lectures. Despite these advantages, a lack of classroom interaction and absence of a strong learning atmosphere have been noted in video conference learning[8].

Although telemedicine in China started relatively late, originated in the mid-1980s, it has developed rapidly [8]. At present, "video conference" has become a common means of continuing education for remote county-level nurses in China [8]. As one of the largest hospitals in China and the world, the First Affiliated Hospital of Zhengzhou University has established the National Telemedicine Center. The hospital pharmacists have been conducting video conferencing pharmacy education (VCPE) for nurses from more than 200 county-level medical institutions through this telemedicine center since 1996. With this VCPE platform, pharmacists can provide training in pharmacy knowledge for nursing staff working in remote areas [9]. To assess the perceptions and learning experience of the county-level nursing staff participating in the VCPE, it is necessary to conduct qualitative studies. The aim of this qualitative study was to gain the knowledge on the perception and expectations of county-level nursing staff (learners) in remote areas towards the VCPE delivery.

METHODS

The study utilized a qualitative, descriptive approach (Sandelowski, 2000) and reporting was based on the Consolidated Criteria for Reporting Qualitative Health Research (COREQ) guidelines. The study was approved by the First Affiliated Hospital of Zhengzhou University Institutional Review Board (No.2019-KY-304).

Study design

A research team was established comprising of two education experts, three pharmacists, and a management expert. All members had experience conducting qualitative studies. Based on literature review, personal experience, and opinions, the multidisciplinary team developed a semi-structured interview guide. Pre-interviews were performed, and revision was made to optimize the interview guide. The final version of the interview guide included three main questions: (1) Please share your real experience of participating in this VCPE. (2) Please share your expectations for VCPE in the future. and (3) What are your suggestions on the content, format, training personnel or time arrangement of VCPE.

We conducted two focus groups at a time convenient for the participants in May 2019 with participants having completed at least one VCPE course. All interviews were digitally recorded with the permission of the participants and then transcribed verbatim. Two interviewers reviewed the transcripts to guarantee accuracy. All original recordings and transcriptions were in Chinese and were translated into English then back-translated into

Chinese to ensure the translation consistency. Transcripts were managed using the NVIVO 12 software (QSR International, Melbourne, VIC).

Recruitment

Participants were selected from two county-level hospitals in Henan, Central China. Purposeful sampling and snowball sampling strategies were used to recruit volunteers. The nursing department leaders at these two hospitals, who have attended our hospital training courses, were asked to recruit study participants. Written informed consents were obtained from all participants prior to study start. The demographic information of the participants was collected.

Data Analysis

Data was analyzed by the Haase's adaptation of Colaizzi's phenomenological method [10]. The code of each participant consists of the corresponding group number and participant number. For example, "G1P1" represents the first participant in the first group. Two team members analyzed the transcripts independently followed by the research team conducting thematic analysis and comparing findings. Themes, theme clusters and representative statements were developed until consensus was achieved. Guidelines were applied to guarantee dependability, transferability, confirmability, and credibility of our study.

Patient and Public Involvement

Patients and the public were not involved in the production of the present research.

RESULTS

The demographics of participants are shown as Table 1. By deeply analyzing the data, the following four domains were extracted: 1) the pharmacy knowledge gains from VCPE, 2) the areas of improvements of the VCPE model, 3) the advantages of the VCPE, and 4) the expectations and suggestions on the VCPE (Fig.1).

3.1 Domain one: the pharmacy knowledge gains of nursing staff from county-level medical institutions participating in the VCPE

The biggest gain reported by participants was the learning of new clinical knowledge and practice pearls.

"I come from the First Department of Cardiovascular Internal Medicine. I think. routine nursing care pays more attention to treatment. After listening to this nutritional knowledge today, I have improved my knowledge of patient care" (G1P1)

"There is a detailed introduction in today's course. For example, when the injection. volume is less than 500 mL every 6 hours, we can continue to use this nutrient pump, to which we did not pay attention before; and there are some tips like headboard elevation" (G2P4)

Due to lack of timely update of knowledge, participants had misconceptions in certain areas of knowledge. This led to the ignorance of details in patient care, such as the weight loss of patients after surgery or nutritional problems found in patients who were bedridden for a long time. After participating in the training, these misconceptions were corrected.

"I am a surgical nurse. I used to think that it is normal for patients to lose weight. after surgery. After listening to the lecture, I understood that this is because the

nutrition after surgery has not kept up. This is a new understanding. In addition, what the teacher said is (laughs) that simply supplementing patients with amino acids or fat emulsions is a waste of resources and is unscientific if not combined with other nutrients, which is also not comprehensive" (G2P3).

For the most part, speakers from higher-level medical institutions were able to share more cutting-edge knowledge through video conferences to county-level nursing staff. The knowledge gained broadened nurses' professional horizon and stimulated their interest and motivation to further learn related knowledge.

"At the beginning, I didn't have a comprehensive understanding of the content of this. course, and then through video learning, I got motivated to understand it more deeply and master some basic knowledge" (G1P12)

"Teaching some cutting-edge knowledge can broaden our horizons. However, maybe. we don't have so much time to learn by ourselves. We are busy at work and we have to take care of the children. Through tele-education, we are opening up some new horizons and see some new knowledge" (G1P11).

3.2 Domain two: areas of improvement of the VCPE delivery of pharmacy knowledge

Most participants mentioned that improvements were needed in the VCPE model. The main problem complained by participants was that many course contents were difficult to understand, especially when they encountered relatively abstract medical indicators, English expressions, or relatively esoteric content. These issues made it difficult for them to understand the course content.

"I learned which indicators were used to judge the patient's nutritional status, but. some specific indicators mentioned by the teacher were not easily understood" (G2P12)

"Many of the guidelines we talked about are in English. The English of our county-level staff is not good, so it is best to translate it into Chinese. Our English level is really not good enough to understand the contents" (G1P9)

"I cannot understand some of the courses. What I heard the most difficult was a. medical course about an electrocardiogram (ECG). Because our hospital carried out projects involving stroke and myocardial infarction, but I didn't understand the ECG course at all" (G1P4)

"I tried hard to understand but still couldn't understand, and there was no chance to. solve the doubts in my mind in time" (G1P9)

Another problem participants noted was about the interaction during lectures. If instructors did not engage in interaction during lectures, the classroom atmosphere appeared to be boring and listeners would have difficulty in understanding the content.

"If the interaction of his video is not good, it will be difficult to understand even though everyone is very interested, the effect will not be good" (G1P8)

"Some questions that were not understood at the time were not asked at the time, and it would be boring without interaction" (G1P12)

Both professional content and clinical content were provided during lectures with a focus on the clinical content. Participants indicated that even though the clinical knowledge

had a certain relevance to patient care, overall, there were inadequate courses for nurses.

"Basically everyone can understand nursing classes, but there are relatively few nursing classes. There may be only one class for nursing a month, and sometimes there may be no class for nursing in a whole month" (G1P6)

Under the traditional face-to-face classroom learning model, learners tend to be more attentive. These factors create a relatively strong learning atmosphere. Compared to this, the VCPE delivery lacked a strong learning atmosphere.

"Compared with studying in the classroom, the biggest disadvantage of this way of learning is that there is no atmosphere" (G2P8)

3.3 Domain three: advantages of the VCPE delivery

Participants emphasized the advantages of the VCPE delivery. The main advantage was convenient and allowed them to choose the time and the content of study.

"This is a selective learning. For example, if I take a break today, I will come to listen the lecture if I have time. If I have work, I will not come. With this frequency, I think it's good, because every day someone will work and someone will rest, and if they are free, they will come" (G1P7)

"The advantage is that our hospital is now free to choose courses. According to your own time, you can come to listen the lecture you choose if you have time. In every department, there are some nurses not on their duties. According to your own time, you can listen to it even if you are not in this department" (G1P3)

Participating in VCPE does not require distant travels, which significantly saves

related travel time and costs.

"*This method does not require you to go to the provincial capital or other big. cities, I can learn it in my own unit. This saves money and time. In the past, it took several days to study in other places. In fact, it would cost a lot of money on travel and accommodation" (G2P3)*

Participants emphasized the importance of learning atmosphere and the learning environment. Some interviewees mentioned that compared with traditional classroom-based learning, the learning atmosphere of VCPE was not strong enough. However, compared with independent online class learning, the learning atmosphere of the VCPE delivery was better.

"Compared with learning online classes alone, this is a better learning atmosphere. If there is a learning atmosphere, everyone wants to learn" (G1P4)

"Ten people are sitting there, nine of them are studying, and the other one who does not want to learn will also start to learn, he will be infected by this atmosphere" (G1P8)

3.4 Domain four: the expectations and suggestions for the VCPE delivery

Participants talked about the learning gains, existing problems, and advantages. On this basis, they put forward expectations and suggestions for VCPE delivery. In terms of teaching content, participants mentioned that they hoped to learn pharmaceutical knowledge related to drug infusion, preparation, administration, and preservation in future training.

"Some drugs have a special order (during infusion), but for most departments, it seems no difference in which bottle to infuse first and which bottle to infuse later, I don't quite understand" (G2P12)

"The aciclovir that we used some time ago is quite special. Our doctor's order was to add two vials of medicines to 100ml of saline, but after two vials of medicines were added, it was impossible to drip, the tube would be blocked and you have to stop dripping (laughs). I really want to know why this happens" (G2P9)

"Our doubt is that some drugs are enteric-coated or slow-released. If we dissolve or crush them, will their effectiveness be affected?" (G2P12)

For teaching content, participants would like to learn about the appropriate use of medications in special populations.

"Especially for pregnant women, sometimes what kind of medicine can be taken when they have a fever. When they are particularly uncomfortable, can they take some antibiotics, can they take cold medicines, and which ones can be taken" (G1P4)

Regarding courseware style, participants mentioned that they hoped that teachers would use actual cases with pictures and texts, and each lecture would not contain too much content.

"It is better to combine with examples, which will impress us deeper. When referring to a case, the lecturer should talk about what was the situation when the patient came, what was used on the first day, just fat emulsion or just amino acids, or two-in-one or three-in-one combination, what was the patient like when they came, and what would

happen to them after a week or five days" (G1P9)

"The lecturer had better not talk too much at a time, because listeners cannot remember too much at a time. The lecturer can talk about a few typical cases at a time, and everyone may understand better" (G1P6)

"There are some theoretical knowledge in pharmacy, which is difficult to grasp. The lecturer had better add a case or picture, which may be more vivid with pictures and texts" (G2P9)

For nurses to better plan their study, interviewees hoped that teachers would communicate learning contents with them in advance.

"If you want to make everyone understand the nursing, you should communicate with the nursing staff in advance. In this way, the lessons you teach may be more acceptable to us" (G1P8)

Another interviewee mentioned that she hoped the lecture content was recorded in the form of videos and stored on the VCPE platform. This would allow nurses to review the video after attending the VCPE sessions.

"Is there that kind of form? Provide us a platform on which we can record courses and click on them anytime after class. In this way, we can learn at home without being restricted by time, place and personnel" (G2P10)

Most interviewees thought that a lecture with a duration of 30 minutes to 40 minutes was more appropriate.

"If the time can be controlled within 30-40 minutes, we think it would be more

appropriate. Although the content will be less, we think we can absorb it better after listening" (G1P11)

Finally, concerning teaching style, participants expected teachers to be passionate and create a good learning atmosphere through interactive methods.

"We hope the teacher to be a little bit passionate during the lecture, which can arouse everyone's enthusiasm and enliven the atmosphere (G2P7).

DISCUSSION

To the best of our knowledge, this is the first qualitative study conducted to obtain the true experiences of receiving pharmacy education through video conferences from the perspective of nurses in China. We found that the main gains for nursing staff at county-level medical institutions, who attended VCPE sessions, were learning new clinical knowledge and practice pearls. The perceptions, expectations, and suggestions of improvement provide a valuable reference to conduct similar continuing education activities in the future.

As identified in our study, nursing staff can learn new knowledge, broaden their horizons, and change previous misconceptions through participating in VCPE[11]. This further inspires their learning motivation[11]. These results are consistent with previous study results. Compared with higher-level medical institutions with a higher degree of specialization, the working environment for county-level nurses is more complex requiring more comprehensive mastering of knowledge. These nurses have a great demand for "Teaching Style" continuing education[12]. However, due to remote locations and a lack of

educational resources, these nurses have difficulties in receiving this type of continuing education[13]. For these nurses, VCPE based on the hospital tele-medicine platform is a valuable asset for education.

At county-level medical institutions in China, there is a shortage of clinical pharmacists in the institutions[14]. Nurses are required to possess certain level of pharmacy knowledge to provide patient care. However, obtaining the knowledge requires a significant investment in time and money. The problem is especially severe as the workload of nurses in China is relatively heavy given the population size[15]. VCPE allows nurses the flexibility to participate in learning[11], and it is suitable to fit in the Chinese healthcare system. Nurses can choose courses according to their interests and professional needs. At the same time, learning other professional knowledge can broaden the horizons of nurses and further stimulate their learning interests[16, 17]. Suggestions made by the study participants on video recording of lectures and the improvement of teaching styles can further improve the VCPE delivery allowing nurses who cannot participate in the real-time learning to watch the videos at their convenient times.

Our study identified several problem areas that deserve improvement. Firstly, due to differences in professional background, the knowledge structure, and work mode, there are differences in the cognition of lecture content between lecturers and learners[18]. The lecturers at higher-level medical institutions are more willing to share the latest guidelines, the most cutting-edge diagnosis and treatment standards, and the most innovative treatment and nursing plans. However, the county-level learners expect that the content of the lectures

to be more closely matched to the care demand at the county level. The mismatch of expectations and actual needs discount the education value[19 20]. Secondly, the current learning atmosphere of VCPE is not as strong as traditional classroom-style learning, which affects the learning effect to a certain extent. Nurses expect teachers to communicate the learning content with them in advance to help them plan and prepare for lectures[21]. Nurses would like teachers to interact with them more often and to have their questions answered in real-time. Nurses want teachers to be passionate during lectures to create a good learning atmosphere[22].

"I don't understand!" and *"How to understand?"* are two issues that our research focused on. Regarding the issue of *"I don't understand!*" the following were commented by participants: 1) Certain content of the course were out of touch with the participants' actual practice. Nurses were looking forward to the content of the course, but sometimes felt that they did not know how to apply the course content to practice[23]. 2) There were too many abstract pharmaceutical parameters or clinical indicators in lectures. Nursing staff mentioned that they indeed hope to understand the *in vivo* process of drugs or judge the clinical status of patients through these clinical parameters or indicators[24]. However, due to differences in professional backgrounds, some specific indicators taught by instructors were difficult to understand by nurses. In addition, the nursing staff said that their English was relatively weak. It was difficult for them to understand specific content with more English terms[25]. 3) There was too much content in a lecture. Due to the differences in the degree of accumulation of professional knowledge, working environment, and education

methods, there were differences in the understanding of the teaching content between instructors and nurses. Instructors hope to deliver more content each time, which made it difficult for participants to understand[26]. 4) The topics of courses were relatively scattered.

Participants made a series of suggestions based on *"how to understand?*", including learning content and teaching methods. The nursing staff clearly mentioned that they were looking forward to learning more about adverse drug reactions, and issues related to drug infusion, drug preparation and drug administration, pharmacology, drug storage, and medications for special populations[27]. In addition, they hope that the course content should be based on actual cases with pictures and texts[28]. Nursing staff conveyed that their teachers should communicate the content in advance to allow them to choose and prepare beforehand. Nursing staff also hope that lecture content can be made into videos for later reviews. "Passion" and "interaction" are the main expectations that the nursing staff mentioned to the teachers. Passionate lectures can arouse the enthusiasm of learners, enlighten the atmosphere, and make it easier for learners to engage[29 30]. Good classroom interaction can not only promote learners to integrate into the classroom, but also prompt learners to clear their confusions in a timely manner.

Our study has the following limitations: 1) The number of subjects was relatively small with participants coming from a single province, Henan, China. However, the study province has a large population and a relatively large number of poverty-stricken areas. The province does reflect the development status of China's remote areas. 2) This research only focused on participants' experiences in VCPE and did not explore their experiences

in knowledge application to practice and the impact of the application in patients' care. These areas will be studied in the near future.

SUMMARY

Compared with the traditional mode, video conferencing pharmacy education delivery to nurses offers convenience, wide accessibility, and savings in time and labor. Organizers should carefully plan course contents related to nursing practice and engage in interactive teaching styles.

Contribution statement Z Y, W Z and X D J designed the study and conducted the interviews. X L Y, Y J Z, X Z, P S analyzed the data. X Z and Y L wrote the manuscript. X J Z and S Z D revised the manuscript.

Conflict of Interests All the authors declare that they have no conflict of interest.

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Patient consent for publication Not required.

Ethics approval Ethics was approved by The First Affiliated Hospital of Zhengzhou University Institutional Review Board approved the protocol (2019-KY-304).

Provenance and peer review Not commissioned; externally peer reviewed.

Data statement Data are available on reasonable request. The thematic data that support the findings of this present study are available from the corresponding author on reasonable request.

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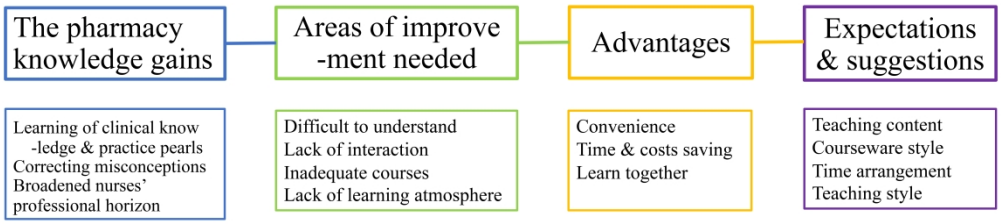
Table1. The demographics of participants (n=23)

ICU, Intensive care unit; VCPE, Video conference pharmacy education; Familiarity with VCPE (very familiar, 5; familiar, 4; generally familiar,3; not familiar,2; not at all,1) ; Expectation of VCPE (very expected, 5; expected, 4; generally expected,3; not expected,2; not at all,1)



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The checklist of the research

Table 1 Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

No Item	Guide questions/description	Answers
Domain 1: Research team and reflexivity		
Personal Characteristics		
1. Interviewer/facilitator	Which author/s conducted the interview or focus group?	Wan Zhang and Zhao Yin
2. Credentials	What were the researcher's credentials? E.g. PhD, MD	MS (Zhao Yin) or BS (Wan Zhang)
3. Occupation	What was their occupation at the time of the study?	Pharmacist
4. Gender	Was the researcher male or female?	Famale (Wan Zhang) and Male (Xuedong Jia and Zhao Yin)
5. Experience and training	What experience or training did the researcher have?	Theoretical training and experience of conducting several qualitative studies with other groups.
Relationship with participants		
6. Relationship established	Was a relationship established prior to study commencement?	Yes
7. Participant knowledge of the interviewer	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	Reasons for doing the research
8. Interviewer characteristics	What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	Reasons and interests in the research topic
Domain 2: study design		
Theoretical framework		
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	Phenomenology.

Participant selection		
10. Sampling	How were participants selected? e.g. purposive, convenience, consecutive, snowball	Purposive and convenience.
11. Method of approach	How were participants approached? e.g. face-to-face, telephone, mail, email	Face to face
12. Sample size	How many participants were in the study?	23
13. Non-participation	How many people refused to participate or dropped out? Reasons?	No one refused and dropped out.
Setting		
14. Setting of data collection	Where was the data collected? e.g. home, clinic, workplace	Home and workplace.
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	No
16. Description of sample	What are the important characteristics of the sample? e.g. demographic data, date	Yes, demographic data.
Data collection		
17. Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Yes
18. Repeat interviews	Were repeat interviews carried out? If yes, how many?	No
19. Audio/visual	Did the research use audio or visual recording to collect the data?	Yes
20. Field notes	Were field notes made during and/or after the interview or focus group?	Yes
21. Duration	What was the duration of the interviews or focus group?	30-45 min

22. Data saturation	Was data saturation discussed?	Yes
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	Yes
Domain 3: analysis and findings		
Data analysis		
24. Number of data coders	How many data coders coded the data?	Two
25. Description of the coding tree	Did authors provide a description of the coding tree?	No
26. Derivation of themes	Were themes identified in advance or derived from the data?	Derived from the data
27. Software	What software, if applicable, was used to manage the data?	NVIVO 12
28. Participant checking	Did participants provide feedback on the findings?	Yes
Reporting		
29. Quotations presented	Were participant quotations presented to illustrate the themes / findings? Was each quotation identified? e.g. participant number	Yes
30. Data and findings consistent	Was there consistency between the data presented and the findings?	Yes
31. Clarity of major themes	Were major themes clearly presented in the findings?	Yes
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Yes

SPQR_21items

Item 1. Title: Concise description of the nature and topic of the study. Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended.
Answer：Yes. Stated in page 1-2.

Item 2. Abstract: Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions.
Answer：Yes. Stated in page 1-3.

Item 3. Problem Formulation: Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement.
Answer：Yes. Stated in page 3-4.

Item 4. Purpose or research question: Purpose of the study and specific objectives or questions.
Answer：Yes. Stated in page 3-4.

Item 5. Qualitative approach and research paradigm: Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., post-positivist, constructivist/interpretivist) is also recommended; rationale
Answer：Yes. Stated in page 5-6.

Item 6. Researcher characteristics and reflexivity: Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results and/or transferability.
Answer：Yes. Stated in page 5.

Item 7. Context: Setting/site and salient contextual factors; rationale.
Answer：Yes. Stated in page 5-6.

Item 8. Sampling strategy: How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale.
Answer：Yes. Stated in page 6.

Item 9. Ethical issues pertaining to human subjects: Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack

thereof; other confidentiality and data security issues.
Answer：Yes. Stated in page 5.

Item 10. Data collection methods: Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale.
Answer：Yes. Stated in page 5-6.

Item 11. Data collection instruments and technologies: Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study.
Answer：Yes. Stated in page 5-6.

Item 12. Units of study: Number and relevant characteristics of participants, documents, or events included in the study; level of participation.
Answer：Yes. Stated in page 6.

Item 13. Data processing: Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding and anonymization / de-identification of excerpts
Answer：Yes. Stated in page 6.

Item 14. Data analysis: Process by which inferences, themes, etc. were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale.
Answer：Yes. Stated in page 6.

Item 15. Techniques to enhance trustworthiness: Techniques to enhance trustworthiness and credibility of data analysis, (e.g., member checking, triangulation, audit trail); rationale
Answer：Yes. Stated in page 6.

Item 16. Synthesis and interpretation: Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory.
Answer：Yes. Stated in page 6-7.

Item 17. Links to empirical data: Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings.
Answer：Yes. Stated in “RESULTS” section.

Item 18. Integration with prior work, implications, transferability, and contribution(s) to the field: Short summary of main findings, explanation of how findings and

conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field.
Answer：Yes. Stated in “DISCUSSION” section.

Item 19. Limitations: Trustworthiness and limitations of findings
Answer：Yes. Stated in page 2.

Item 20. Conflicts of interest: Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed.
Answer：Yes. Stated in page 18.

Item 21. Funding: Sources of funding and other support; role of funders in data collection, interpretation, and reporting.
Answer：Yes. Stated in page 18.

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Exploring the perceptions and barriers of nurses working in remote areas on tele-educational delivery of pharmacy knowledge in Henan China: a qualitative study

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Exploring the perceptions and barriers of nurses working in remote areas on tele-educational delivery of pharmacy knowledge in Henan China: a qualitative study

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ABSTRACT

Objective

There are insufficient educational resources and opportunities available to nurses at county-level medical institutions in China to receive pharmacy knowledge education. Video conference pharmacy education (VCPE) has become a solution. However, few studies have explored the perceptions of nurses participating in VCPE. The study was aimed to explore the perceptions of nurses participating in VCPE at county-level medical institutions in remote areas in China. The barriers and suggestions to improve the VCPE were also assessed.

Setting The study was conducted in two county-level hospitals in Henan, China.

Design and participants This qualitative study comprises two focus group discussions. Twenty-three nurses from two county-level hospitals in Henan Province participated in the interview in May 2019.

Results The average age of our participants was 34.83±6.24 years old (from 26 to 55 years old). By deeply analyzing the data, the following four domains were extracted: Four themes were extracted on VCPE from this qualitative study: 1) the pharmacy knowledge gains from VCPE, 2) the shortcomings VCPE, 3) the advantages of the VCPE, and 4) the expectations and suggestions for the VCPE.

Conclusion

The results of this study indicate VCPE is a valuable tool to provide education to nurses working at remote area county-level institutions. The results contribute to improvements in future VCPE deliveries.

Strengths and limitations of this study

This is the first qualitative study in Mainland China to explore the experience and expectations of nurses participating in remote pharmacy knowledge training.

The present relies on in-depth group discussions and interviews, providing rich data on the experiences of participants.

The research subjects only included nursing staff from two hospitals in Henan Province, which has certain limitations.

Another limitation includes potential for sexual bias since all of the participants are females.

Keywords

Tele-education; Pharmacy knowledge; Video-conference; Nurse; Remote areas; Qualitative research

INTRODUCTION

In China, clinical pharmacy services provided at hospital settings only started in the early 1990s[1], resulting in a shortage of clinical pharmacists and poor pharmacy support for nurses or other medical stuff at remote county-level medical institutions[2 3]. Studies have indicated that nursing staff, working at these medical institutions, need to receive pharmacy training to care for patients[4]. Pharmacology education generally includes 1) drug information, such as preparation, administration, and storage; 2) basic knowledge of pharmacotherapy, chronopharmacology, and pharmacokinetics; 3) ability to monitor drug efficacy and adverse drug reaction; and 4) appropriate drug use in pregnant patients, elderly patients, and pediatric patients[5]. However, due to the remote location, nurses are struggling to get educational resources and opportunities at the places they work. Traditionally, they have to attend in-person classroom learning or conferences hosted at larger cities[6], which requires an expense of time and money. Using information technology and video conferencing capabilities, tele-education has been explored to solve this problem[7]. Compared with the traditional model, video conference training is efficient, saving both time and money[8]. Under this new model, close cooperation and alliance relationships between county-level and higher-level medical institutions can be established. With video

conference learning, learners have the option to attend real-time or conduct home study through watching recorded lectures. Despite these advantages, a lack of classroom interaction and absence of a strong learning atmosphere have been noted in video conference learning[8].

Although telemedicine in China started relatively late, originated in the mid-1980s, it has developed rapidly [9]. At present, "video conference" has become a common means of continuing education for remote county-level nurses in China [9]. As one of the largest hospitals in China and the world, the First Affiliated Hospital of Zhengzhou University has established the National Telemedicine Center. The hospital pharmacists have been conducting video conferencing pharmacy education (VCPE) for nurses from more than 200 county-level medical institutions through this telemedicine center since 1996. With this VCPE platform, pharmacists can provide continuing education in pharmacy knowledge for nursing staff working in remote areas [10]. To assess the perceptions and learning experience of the county-level nursing staff participating in the VCPE and better evaluate program outcomes, it is necessary to conduct qualitative studies. The aim of this qualitative study was to gain knowledge about the perceptions and expectations of county-level nursing staff (learners) in remote areas towards the VCPE delivery.

METHODS

Giving that the aim of this study was to describe the perceptions of nurses participating in VCPE at county-level hospitals in remote areas in China, a qualitative

descriptive approach was utilized (Sandelowski, 2000). Reporting was based on the Consolidated Criteria for Reporting Qualitative Health Research (COREQ) guidelines. The study was approved by the First Affiliated Hospital of Zhengzhou University Institutional Review Board (No.2019-KY-304).

Study design

A research team was established comprised of two education experts, three pharmacists, and a management expert. Among them, education experts are mainly involved in the design of research plans and the formulation of interview guide. The three pharmacists are mainly responsible for the design of the research plan, the implementation of focus group interviews, data analyzing and manuscript writing. The management expert is mainly responsible for methodological guidance and quality control. All members had experience conducting qualitative studies. Based on literature review, personal experience, and opinions, the multidisciplinary team developed a semi-structured interview guide. Pre-interviews were performed, and revision was made to optimize the interview guide. The final version of the interview guide included three main questions: (1) Please share your real experience of participating in this VCPE. (2) Please share your expectations for VCPE in the future. and (3) What are your suggestions on the content, format, training personnel or time arrangement of VCPE.

VCPE is developed with the support of the video-education platform of the National Telemedicine Center. County-level hospitals participating in the project have established close network connections with provincial hospitals such as the First Affiliated Hospital of

Zhengzhou University. In this project, the main teaching unit is the department of pharmacy of the First Affiliated Hospital of Zhengzhou University, and the teachers are generally experienced clinical pharmacists or dispensing pharmacists. Online classes are arranged twice a month, usually at 3:00 pm on Mondays in the first or third week. Each lesson lasts about 50 minutes. The teaching syllabus is prepared in advance every year, and the courseware is reviewed by a pharmacy expert group, and the teaching can be carried out after passing. The main content of the course includes the daily management of drugs, the rational use of antibacterial drugs, the management and rational use of opiates or psychotropic substances, medication therapy management (MTM) for chronic diseases, pharmacoeconomics, and so on. Before each online class, a manager in charge of the telemedicine center publishes the teaching content on the platform, and lower-level hospitals can freely choose. The lower-level hospitals then organize their medical staff to study through video and evaluate them accordingly. We conducted two focus groups at a time convenient for the participants in May 2019 with participants having completed at least one VCPE course. All interviews were digitally recorded with the permission of the participants and then transcribed verbatim. Two interviewers reviewed the transcripts to guarantee accuracy. All original recordings and transcriptions were in Chinese and were translated into English then back-translated into Chinese to ensure the translation consistency. Transcripts were managed using the NVIVO 12 software (QSR International, Melbourne, VIC).

Recruitment

Participants were selected from two county-level hospitals in Henan, Central China. Those two hospitals are located in remote areas of Henan Province, and the nearest large provincial hospitals are more than 200km away. In addition, according to previous records, the two hospitals have a relatively high enthusiasm for participating in VCPE. The inclusion criteria of the research subjects are as follows: (1) Nurses who formally work in these two hospitals; (2) Finished at least one complete VCPE course; (3) Willing to participate in this study. Purposeful sampling and snowball sampling strategies were used to recruit volunteers. Before the interview, the research team communicated with the potential participants of the two hospitals in advance to determine the time and place to participate in the interview. 23 participants were included in the study until data saturation was achieved. Written informed consents were then obtained from all participants prior to study start. The demographic information of the participants was collected.

Data Analysis

Data was analyzed by the Haase's adaptation of Colaizzi's phenomenological method [11], shown as figure 1. The code of each participant consists of the corresponding group number and participant number. For example, "G1P1" represents the first participant in the first group. Two team members analyzed the transcripts independently followed by the research team conducting thematic analysis and comparing findings. Themes, theme clusters and representative statements were developed until consensus was achieved. Guidelines were applied to guarantee dependability, transferability, confirmability, and credibility of our study.

Trustworthy

To maintain trustworthiness, the following was taken into consideration: (1) investigators communicated frequently with guidance experts, (2) interview data were returned to participants to confirm that the investigator's understanding coincided with the meaning the participants wanted to express, (3) guidance of conducting qualitative study were strictly followed during researching.

Patient and Public Involvement

Patients and the public were not involved in this research initiative.

RESULTS

23 nurses (all were females) were enrolled in the present study, with an average age of 34.83±6.24 years old (from 26 to 55 years old). The demographics of participants are shown as Table 1. By deeply analyzing the data, the following four domains were extracted: 1) the pharmacy knowledge gains from VCPE, 2) the shortcomings VCPE, 3) the advantages of the VCPE, and 4) the expectations and suggestions for the VCPE (Fig.2).

3.1 Domain one: the pharmacy knowledge gains of nursing staff from county-level medical institutions participating in the VCPE

The biggest gain reported by participants was the learning of new clinical knowledge and practice pearls.

"I come from the First Department of Cardiovascular Internal Medicine. I think. routine nursing care pays more attention to treatment. After listening to this

nutritional knowledge today, I have improved my knowledge of patient care" (G1P1)

"There is a detailed introduction in today's course. For example, when the injection. volume is less than 500 mL every 6 hours, we can continue to use this nutrient pump, to which we did not pay attention before; and there are some tips like headboard elevation" (G2P4)

Due to lack of timely continuing education about pharmacology, participants had misconceptions that needed to be addressed to improve the delivery of care. The VCPE addressed details in patient care, such as the weight loss of patients after surgery , and nutritional problems found in patients who were bedridden for a long time. After participating in the training, these misconceptions were corrected.

"I am a surgical nurse. I used to think that it is normal for patients to lose weight. after surgery. After listening to the lecture, I understood that this is because the nutrition after surgery has not kept up. This is a new understanding. In addition, what the teacher said is (laughs) that simply supplementing patients with amino acids or fat emulsions is a waste of resources and is unscientific if not combined with other nutrients, which is also not comprehensive" (G2P3).

For the most part, speakers from higher-level medical institutions were able to share more up to date knowledge through video conferences for county-level nursing staff. The knowledge gained broadened nurses' professional horizon and stimulated their interest and motivation to further learn related knowledge.

"*At the beginning, I didn't have a comprehensive understanding of the content of this.*

course, and then through video learning, I got motivated to understand it more deeply and master some basic knowledge" (G1P12)

"*Teaching some cutting-edge knowledge can broaden our horizons. However, maybe. we don't have so much time to learn by ourselves. We are busy at work and we have to take care of the children. Through tele-education, we are opening up some new horizons and see some new knowledge" (G1P11).*

3.2 Domain two: the shortcomings VCPE

Most participants mentioned that improvements were needed in the VCPE model. The main problem identified by participants was that course content was difficult to understand, especially when they encountered relatively abstract medical indicators, English expressions, or relatively esoteric content.

"*I learned which indicators were used to judge the patient's nutritional status, but. some specific indicators mentioned by the teacher were not easily understood" (G2P12)*

"Many of the guidelines we talked about are in English. The English of our county-level staff is not good, so it is best to translate it into Chinese. Our English level is really not good enough to understand the contents" (G1P9)

"I cannot understand some of the courses. What I heard the most difficult was a. medical course about an electrocardiogram (ECG). Because our hospital carried out projects involving stroke and myocardial infarction, but I didn't understand the ECG course at all" (G1P4)

"I tried hard to understand but still couldn't understand, and there was no chance to. solve the doubts in my mind in time" (G1P9)

Another problem participants noted was about the interaction during lectures. If instructors did not engage in interaction during lectures, the classroom atmosphere appeared to be boring and listeners would have difficulty in understanding the content.

"If the interaction of his video is not good, it will be difficult to understand even though everyone is very interested, the effect will not be good" (G1P8)

"Some questions that were not understood at the time were not asked at the time, and it would be boring without interaction" (G1P12)

Both professional content and clinical content were provided during lectures with a focus on the clinical content. Participants indicated that even though the clinical knowledge had a certain relevance to patient care, overall, there were inadequate courses for nurses.

"Basically everyone can understand nursing classes, but there are relatively few nursing classes. There may be only one class for nursing a month, and sometimes there may be no class for nursing in a whole month" (G1P6)

Under the traditional face-to-face classroom learning model, learners can be more engaged in the content and tend to be more attentive. These factors create an atmosphere conducive to learning. Compared to this, the VCPE delivery lacked a strong learning atmosphere to engage the learner.

"Compared with studying in the classroom, the biggest disadvantage of this way of learning is that there is no atmosphere" (G2P8)

3.3 Domain three: advantages of the VCPE delivery

Participants emphasized the advantages of the VCPE delivery. The main advantage was convenience, which allowed them to choose the time and the content of study.

"This is a selective learning. For example, if I take a break today, I will come to listen the lecture if I have time. If I have work, I will not come. With this frequency, I think it's good, because every day someone will work and someone will rest, and if they are free, they will come" (G1P7)

"The advantage is that our hospital is now free to choose courses. According to your own time, you can come to listen the lecture you choose if you have time. In every department, there are some nurses not on their duties. According to your own time, you can listen to it even if you are not in this department" (G1P3)

Participating in VCPE does not require distant travels, which significantly saves related travel time and costs.

"*This method does not require you to go to the provincial capital or other big. cities, I can learn it in my own unit. This saves money and time. In the past, it took several days to study in other places. In fact, it would cost a lot of money on travel and accommodation" (G2P3)*

Participants emphasized the importance of learning atmosphere and the learning environment. Some interviewees mentioned that compared with traditional classroom-based learning, the learning atmosphere of VCPE was not strong enough. However, compared with independent online class learning, the learning atmosphere of the VCPE

delivery was better.

"Compared with learning online classes alone, this is a better learning atmosphere. If there is a learning atmosphere, everyone wants to learn" (G1P4)

"Ten people are sitting there, nine of them are studying, and the other one who does not want to learn will also start to learn, he will be infected by this atmosphere" (G1P8)

3.4 Domain four: the expectations and suggestions for the VCPE delivery

Participants talked about the learning gains, existing problems, and advantages. On this basis, they put forward specific expectations and suggestions for VCPE delivery. In terms of teaching content, participants mentioned that they hoped to learn pharmaceutical knowledge related to drug infusion, preparation, administration, and preservation in future continuing education.

"Some drugs have a special order (during infusion), but for most departments, it seems no difference in which bottle to infuse first and which bottle to infuse later, I don't quite understand" (G2P12)

"The aciclovir that we used some time ago is quite special. Our doctor's order was to add two vials of medicines to 100ml of saline, but after two vials of medicines were added, it was impossible to drip, the tube would be blocked and you have to stop dripping (laughs). I really want to know why this happens" (G2P9)

"Our doubt is that some drugs are enteric-coated or slow-released. If we dissolve or crush them, will their effectiveness be affected?" (G2P12)

For teaching content, participants would like to learn about the appropriate use of medications in special populations.

"Especially for pregnant women, sometimes what kind of medicine can be taken when they have a fever. When they are particularly uncomfortable, can they take some antibiotics, can they take cold medicines, and which ones can be taken" (G1P4)

Regarding courseware style, participants mentioned that they hoped that teachers would use actual cases with pictures and texts, and each lecture would not contain too much content.

"It is better to combine with examples, which will impress us deeper. When referring to a case, the lecturer should talk about what was the situation when the patient came, what was used on the first day, just fat emulsion or just amino acids, or two-in-one or three-in-one combination, what was the patient like when they came, and what would happen to them after a week or five days" (G1P9)

"The lecturer had better not talk too much at a time, because listeners cannot remember too much at a time. The lecturer can talk about a few typical cases at a time, and everyone may understand better" (G1P6)

"There are some theoretical knowledge in pharmacy, which is difficult to grasp. The lecturer had better add a case or picture, which may be more vivid with pictures and texts" (G2P9)

For nurses to better plan their study, interviewees hoped that teachers would communicate learning contents with them in advance.

"If you want to make everyone understand the nursing, you should communicate with the nursing staff in advance. In this way, the lessons you teach may be more acceptable to us" (G1P8)

Another interviewee mentioned that she hoped the lecture content was recorded in the form of videos and stored on the VCPE platform. This would allow nurses to review the video after attending the VCPE sessions.

"Is there that kind of form? Provide us a platform on which we can record courses and click on them anytime after class. In this way, we can learn at home without being restricted by time, place and personnel" (G2P10)

Most interviewees thought that a lecture with a duration of 30 minutes to 40 minutes was more appropriate.

"If the time can be controlled within 30-40 minutes, we think it would be more appropriate. Although the content will be less, we think we can absorb it better after listening" (G1P11)

Finally, concerning teaching style, participants expected teachers to be passionate and create a good learning atmosphere through interactive methods.

"We hope the teacher to be a little bit passionate during the lecture, which can arouse everyone's enthusiasm and enliven the atmosphere (G2P7).

DISCUSSION

The research team believes this initiative to be the first qualitative study conducted to obtain an understanding of the acceptability of receiving pharmacy education through

video conferencing from the perspective of nurses in China. Study results found that the main gains for nursing staff at county-level medical institutions, who attended VCPE sessions, were learning new clinical knowledge and practice pearls. The perceptions, expectations, and suggestions of improvement provide a valuable reference to conduct similar continuing education activities in the future.

As identified in this study, nursing staff can complete continuing education that effectively addresses knowledge gaps and patient care misconceptions through participating in VCPE[12]. This further inspires their learning motivation[12]. Compared with higher-level hospitals, such as provincial hospitals with higher degrees of specialization, the working environment for county-level nurses is more complex requiring more comprehensive mastering of knowledge. These nurses have a great demand for active learning and engagement in continuing education[13]. However, due to remote locations and a lack of educational resources, these nurses have difficulties in accessing face-to face continuing education[14]. For these nurses, VCPE delivered using the hospital tele-medicine platform is a valuable asset for education.

At county-level medical institutions in China, there is a shortage of clinical pharmacists in the institutions[15]. Nurses are required to possess certain level of pharmacy knowledge without access to the support of a clinical pharmacist to provide patient care. However, obtaining the continuing education needed requires a significant investment in time and money. The problem is especially severe as the workload of nurses in China is relatively heavy given the population size[16]. VCPE allows nurses the flexibility to access

learning[12], and it is suitable to fit in the Chinese healthcare system. Nurses can choose courses according to their interests and professional needs. At the same time, interprofessional learning can broaden the horizons of nurses and further stimulate their learning interests[17 18]. Suggestions made by the study participants on video recording of lectures and the improvement of teaching styles can further improve the VCPE delivery allowing nurses who cannot participate in the real-time learning to watch the videos at their convenient times.

This study identified several problem areas that deserve improvement. Firstly, lecturers need to appreciate the learning needs of the county nurses and use a style of presentation that actively engages the learners[19]. The lecturers at higher-level medical institutions are willing to share the latest evidence-based guidelines and diagnosis and treatment standards, which includes how to innovate treatment and nursing care. However, the county-level learners expect that the content of the lectures to be more closely matched to the care demand at the county level. The mismatch of expectations for how to apply the continuing education content and actual content delivery discount the education value[20 21]. The current learning atmosphere of VCPE does not engage the participants in the same manner traditional classroom-style learning, which affects learning. Feedback revealed that nurses expect teachers to communicate the learning content with them in advance to help them plan and prepare for lectures[22]. Nurses would like teachers to interact with them more often and to have their questions answered in real-time. Nurses want teachers to be passionate during lectures to create a good learning atmosphere[23].

"I don't understand!" and *"How to understand?"* are two statements that this research study prioritized in qualitative content analysis. Regarding the issue of *"I don't understand!"* the following were commented by participants: 1) Certain content of the course were out of touch with the participants' actual practice. Nurses were looking forward to the content of the course, but sometimes felt that they did not know how to apply the course content to practice[24]. 2) There were too many abstract pharmaceutical parameters or clinical indicators in lectures. Nursing staff mentioned that they indeed hope to understand the *in vivo* process of drugs or judge the clinical status of patients through these clinical parameters or indicators[25]. However, due to differences in professional backgrounds, some specific indicators taught by instructors were difficult to understand by nurses. In addition, the nursing staff said that their English was relatively weak. It was difficult for them to understand specific content with more English terms[26]. 3) There was too much content in a lecture. Instructors hoped to deliver more content each time, which made it difficult for participants to understand[27]. 4) The topics of courses were relatively scattered. Therefore, teaching strategies need to be adapted to the learner and the online learning environment.

Participants made a series of suggestions based on *"how to understand?"*, including learning content and teaching methods. The nursing staff clearly mentioned that they were looking forward to learning more about adverse drug reactions, and issues related to drug infusion, drug preparation and drug administration, pharmacology, drug storage, and medications for special populations[28]. In addition, they hope that the course content should be based on actual cases with pictures and texts[29]. Nursing staff conveyed that their teachers

should communicate the content in advance to allow them to choose and prepare beforehand. Nursing staff also hope that lecture content can be made into videos for later reviews. "Passion" and "interaction" are the main expectations that the nursing staff mentioned to the teachers. Passionate lectures can arouse the enthusiasm of learners, enlighten the atmosphere, and make it easier for learners to engage [30 31]. Good classroom interaction can not only promote learners to integrate into the classroom, but also prompt learners to clear their confusions in a timely manner.

This study has the following limitations: 1) The number of subjects was relatively small with participants coming from a single province, Henan, China. However, the study province has a large population and a relatively large number of underserved areas. The province does reflect the development status of China's remote areas. 2) This research only focused on participants' experiences in VCPE and did not explore their experiences in knowledge application to practice and the impact of the application in patients' care. These areas will be studied in the future.

SUMMARY

Compared with the traditional mode of in-person continuing education, video conferencing pharmacy education delivery to nurses offers convenience, wide accessibility, and savings in time and labor. Organizers should carefully plan course content related to nursing practice and engage in interactive teaching styles.

Contribution statement Z Y, W Z and X D J designed the study and conducted the interviews. X L Y, Y J Z, X Z, P S analyzed the data. X Z and Y L wrote the manuscript. X J Z and S Z D revised the manuscript.

Conflict of Interests All the authors declare that they have no conflict of interest.

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Patient consent for publication Not required.

Ethics approval Ethics was approved by The First Affiliated Hospital of Zhengzhou University Institutional Review Board approved the protocol (2019-KY-304).

Provenance and peer review Not commissioned; externally peer reviewed.

Data statement Data are available on reasonable request. The thematic data that support the findings of this present study are available from the corresponding author on reasonable request.

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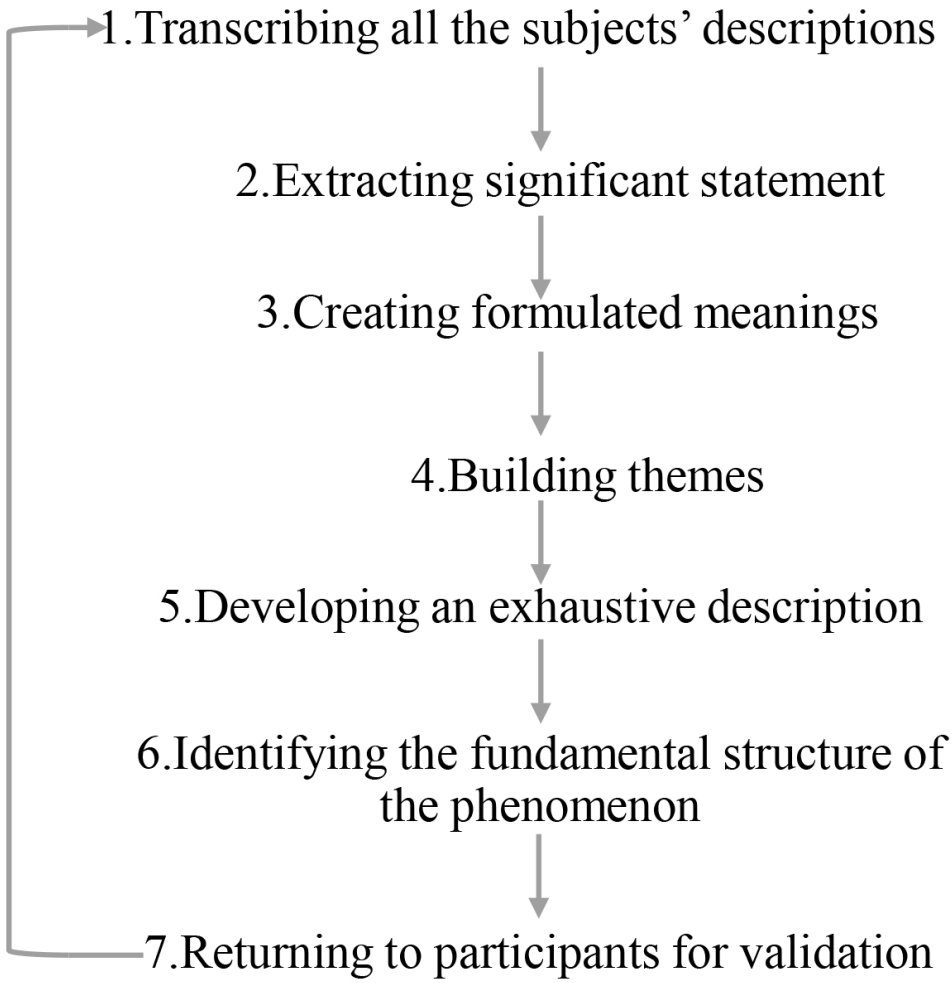
Table1. The demographics of participants (n=23)

ICU, Intensive care unit; VCPE, Video conference pharmacy education; Familiarity with VCPE (very familiar, 5; familiar, 4; generally familiar,3; not familiar,2; not at all,1) ; Expectation of VCPE (very expected, 5; expected, 4; generally expected,3; not expected,2; not at all,1)



The whole step of Colaizzi's phenomenological method.

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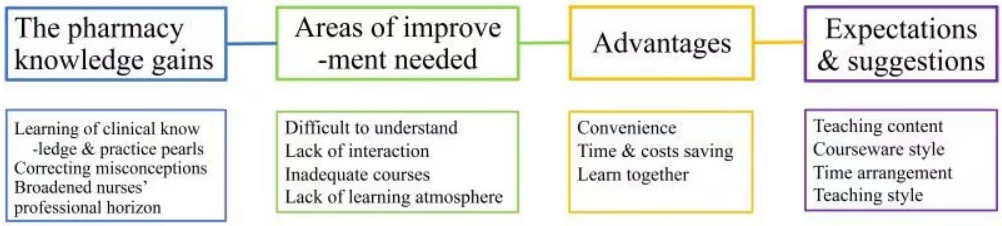

The framework of domains

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SPQR_21items

Item 1. Title: Concise description of the nature and topic of the study. Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended.
Answer：Yes. Stated in page 1, lines 1-2.

Item 2. Abstract: Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions.
Answer：Yes. Stated in pages 1-2, lines 12-33.

Item 3. Problem Formulation: Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement.
Answer：Yes. Stated in page 3-4, lines 48-67.

Item 4. Purpose or research question: Purpose of the study and specific objectives or questions.
Answer：Yes. Stated in page 4, lines 76-80.

Item 5. Qualitative approach and research paradigm: Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., post-positivist, constructivist/interpretivist) is also recommended; rationale
Answer：Yes. Stated in page 4-5, lines 83-85.

Item 6. Researcher characteristics and reflexivity: Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results and/or transferability.
Answer：Yes. Stated in page 5, lines 90-96.

Item 7. Context: Setting/site and salient contextual factors; rationale.
Answer：Yes. Stated in page 7, lines 127-130.

Item 8. Sampling strategy: How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale.
Answer：Yes. Stated in page 7, lines 127-137.

Item 9. Ethical issues pertaining to human subjects: Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack

thereof; other confidentiality and data security issues.
Answer：Yes. Stated in page 4, lines 86-88.

Item 10. Data collection methods: Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale.
Answer：Yes. Stated in page 6, lines 118-120.

Item 11. Data collection instruments and technologies: Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study.
Answer：Yes. Stated in page 6, lines 120-125.

Item 12. Units of study: Number and relevant characteristics of participants, documents, or events included in the study; level of participation.
Answer：Yes. Stated in page 8, lines 158-159. Detailed information of participants is shown in Table 1.

Item 13. Data processing: Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding and anonymization / de-identification of excerpts
Answer：Yes. Stated in page 6, lines 120-124.

Item 14. Data analysis: Process by which inferences, themes, etc. were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale.
Answer：Yes. Stated in page 6. lines 140-147.

Item 15. Techniques to enhance trustworthiness: Techniques to enhance trustworthiness and credibility of data analysis, (e.g., member checking, triangulation, audit trail); rationale
Answer：Yes. Stated in page 8, lines 148-153.

Item 16. Synthesis and interpretation: Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory.
Answer：Yes. Stated in page 19, lines 393-397.

Item 17. Links to empirical data: Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings.
Answer：Yes. Stated in “RESULTS” section.

Item 18. Integration with prior work, implications, transferability, and contribution(s) to the field: Short summary of main findings, explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field.
Answer：Yes. Stated in page 19, lines 393-397.

Item 19. Limitations: Trustworthiness and limitations of findings
Answer：Yes. Stated in page 19, lines 385-391.

Item 20. Conflicts of interest: Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed.
Answer：Yes. Stated in page 20, line 401.

Item 21. Funding: Sources of funding and other support; role of funders in data collection, interpretation, and reporting.
Answer：Yes. Stated in page 19, line 402.

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Exploring the perceptions and barriers of nurses working in remote areas on tele-educational delivery of pharmacy knowledge in Henan China: a qualitative study

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Primary Subject Heading:	Medical education and training
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Exploring the perceptions and barriers of nurses working in remote areas on tele-educational delivery of pharmacy knowledge in Henan China: a qualitative study

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ABSTRACT

Objective

There are insufficient educational resources and opportunities available to nurses at county-level medical institutions in China to receive pharmacy knowledge education. Video conference pharmacy education (VCPE) has become a solution. However, few studies have explored the perceptions of nurses participating in VCPE. The study was aimed to explore the perceptions of nurses participating in VCPE at county-level medical institutions in remote areas in China. The barriers and suggestions to improve the VCPE were also assessed.

Setting The study was conducted in two county-level hospitals in Henan, China.

Design and participants This qualitative study comprises two focus group discussions. Twenty-three nurses from two county-level hospitals in Henan Province participated in the interview in May 2019.

Results The average age of our participants was 34.83±6.24 years old (from 26 to 55 years old). By deeply analyzing the data, the following four domains were extracted: Four themes were extracted on VCPE from this qualitative study: 1) the pharmacy knowledge gains from VCPE, 2) the shortcomings VCPE, 3) the advantages of the VCPE, and 4) the expectations and suggestions for the VCPE.

Conclusion

The results of this study indicate VCPE is a valuable tool to provide education to nurses working at remote area county-level institutions. The results contribute to improvements in future VCPE deliveries.

Strengths and limitations of this study

This is the first qualitative study in Mainland China to explore the experience and expectations of nurses participating in remote pharmacy knowledge training.

The present relies on in-depth group discussions and interviews, providing rich data on the experiences of participants.

The research subjects only included nursing staff from two hospitals in Henan Province, which has certain limitations.

Another limitation includes potential for sexual bias since all of the participants are females.

Keywords

Tele-education; Pharmacy knowledge; Video-conference; Nurse; Remote areas; Qualitative research

INTRODUCTION

In China, clinical pharmacy services provided at hospital settings only started in the early 1990s[1], resulting in a shortage of clinical pharmacists and poor pharmacy support for nurses or other medical stuff at remote county-level medical institutions[2 3]. Studies have indicated that nursing staff, working at these medical institutions, need to receive pharmacy training to care for patients[4]. Pharmacology education generally includes 1) drug information, such as preparation, administration, and storage; 2) basic knowledge of pharmacotherapy, chronopharmacology, and pharmacokinetics; 3) ability to monitor drug efficacy and adverse drug reaction; and 4) appropriate drug use in pregnant patients, elderly patients, and pediatric patients[5]. However, due to the remote location, nurses are struggling to get educational resources and opportunities at the places they work. Traditionally, they have to attend in-person classroom learning or conferences hosted at larger cities[6], which requires an expense of time and money. Using information technology and video conferencing capabilities, tele-education has been explored to solve this problem[7]. Compared with the traditional model, video conference training is efficient, saving both time and money[8]. Under this new model, close cooperation and alliance relationships between county-level and higher-level medical institutions can be established. With video

conference learning, learners have the option to attend real-time or conduct home study through watching recorded lectures. Despite these advantages, a lack of classroom interaction and absence of a strong learning atmosphere have been noted in video conference learning[8].

Although telemedicine in China started relatively late, originated in the mid-1980s, it has developed rapidly [9]. At present, "video conference" has become a common means of continuing education for remote county-level nurses in China [9]. As one of the largest hospitals in China and the world, the First Affiliated Hospital of Zhengzhou University has established the National Telemedicine Center. The hospital pharmacists have been conducting video conferencing pharmacy education (VCPE) for nurses from more than 200 county-level medical institutions through this telemedicine center since 1996. With this VCPE platform, pharmacists can provide continuing education in pharmacy knowledge for nursing staff working in remote areas [10]. To assess the perceptions and learning experience of the county-level nursing staff participating in the VCPE and better evaluate program outcomes, it is necessary to conduct qualitative studies. The aim of this qualitative study was to gain knowledge about the perceptions and expectations of county-level nursing staff (learners) in remote areas towards the VCPE delivery.

METHODS

Giving that the aim of this study was to describe the perceptions of nurses participating in VCPE at county-level hospitals in remote areas in China, a qualitative

descriptive approach was utilized (Sandelowski, 2000). Reporting was based on the Consolidated Criteria for Reporting Qualitative Health Research (COREQ) guidelines. The study was approved by the First Affiliated Hospital of Zhengzhou University Institutional Review Board (No.2019-KY-304).

Study design

A research team was established comprised of two education experts, three pharmacists, and a management expert. Among them, education experts are mainly involved in the design of research plans and the formulation of interview guide. The three pharmacists are mainly responsible for the design of the research plan, the implementation of focus group interviews, data analyzing and manuscript writing. The management expert is mainly responsible for methodological guidance and quality control. All members had experience conducting qualitative studies. Based on literature review, personal experience, and opinions, the multidisciplinary team developed a semi-structured interview guide. Pre-interviews were performed, and revision was made to optimize the interview guide. The final version of the interview guide included three main questions: (1) Please share your real experience of participating in this VCPE. (2) Please share your expectations for VCPE in the future. and (3) What are your suggestions on the content, format, training personnel or time arrangement of VCPE.

VCPE is developed with the support of the video-education platform of the National Telemedicine Center. County-level hospitals participating in the project have established close network connections with provincial hospitals such as the First Affiliated Hospital of

Zhengzhou University. In this project, the main teaching unit is the department of pharmacy of the First Affiliated Hospital of Zhengzhou University, and the teachers are generally experienced clinical pharmacists or dispensing pharmacists. Online classes are arranged twice a month, usually at 3:00 pm on Mondays in the first or third week. Each lesson lasts about 50 minutes. The teaching syllabus is prepared in advance every year, and the courseware is reviewed by a pharmacy expert group, and the teaching can be carried out after passing. The main content of the course includes the daily management of drugs, the rational use of antibacterial drugs, the management and rational use of opiates or psychotropic substances, medication therapy management (MTM) for chronic diseases, pharmacoeconomics, and so on. Before each online class, a manager in charge of the telemedicine center publishes the teaching content on the platform, and lower-level hospitals can freely choose. The lower-level hospitals then organize their medical staff to study through video and evaluate them accordingly. We conducted two focus groups at a time convenient for the participants in May 2019 with participants having completed at least one VCPE course. All interviews were digitally recorded with the permission of the participants and then transcribed verbatim. Two interviewers reviewed the transcripts to guarantee accuracy. All original recordings and transcriptions were in Chinese and were translated into English then back-translated into Chinese to ensure the translation consistency. Transcripts were managed using the NVIVO 12 software (QSR International, Melbourne, VIC).

Recruitment

Participants were selected from two county-level hospitals in Henan, Central China. Those two hospitals are located in remote areas of Henan Province, and the nearest large provincial hospitals are more than 200km away. In addition, according to previous records, the two hospitals have a relatively high enthusiasm for participating in VCPE. The inclusion criteria of the research subjects are as follows: (1) Nurses who formally work in these two hospitals; (2) Finished at least one complete VCPE course; (3) Willing to participate in this study. Purposeful sampling and snowball sampling strategies were used to recruit volunteers. Before the interview, the research team communicated with the potential participants of the two hospitals in advance to determine the time and place to participate in the interview. 23 participants were included in the study until data saturation was achieved. Written informed consents were then obtained from all participants prior to study start. The demographic information of the participants was collected.

Data Analysis

Data was analyzed by the Haase's adaptation of Colaizzi's phenomenological method [11], shown as figure 1. The code of each participant consists of the corresponding group number and participant number. For example, "G1P1" represents the first participant in the first group. Two team members analyzed the transcripts independently followed by the research team conducting thematic analysis and comparing findings. Themes, theme clusters and representative statements were developed until consensus was achieved. Guidelines were applied to guarantee dependability, transferability, confirmability, and credibility of our study.

Trustworthy

To maintain trustworthiness, the following was taken into consideration: (1) investigators communicated frequently with guidance experts, (2) interview data were returned to participants to confirm that the investigator's understanding coincided with the meaning the participants wanted to express, (3) guidance of conducting qualitative study were strictly followed during researching.

Patient and Public Involvement

Patients and the public were not involved in this research initiative.

RESULTS

23 nurses (all were females) were enrolled in the present study, with an average age of 34.83±6.24 years old (from 26 to 55 years old). Their average time to participate in nursing work was 11.13 ± 7.26 years. These participants were enrolled from multiple departments, which included ICU (6), rehabilitation (4), surgery (4), neurology (2), administration (2), internal medicine (1), cardiology (1), ophthalmology (1) and neurosurgery (1). The demographics of participants are shown as Table 1. By deeply analyzing the data, the following four domains were extracted: 1) the pharmacy knowledge gains from VCPE, 2) the shortcomings VCPE, 3) the advantages of the VCPE, and 4) the expectations and suggestions for the VCPE (Fig.2).

3.1 Domain one: the pharmacy knowledge gains of nursing staff from county-level medical institutions participating in the VCPE

The biggest gain reported by participants was the learning of new clinical knowledge and practice pearls.

"I come from the First Department of Cardiovascular Internal Medicine. I think. routine nursing care pays more attention to treatment. After listening to this nutritional knowledge today, I have improved my knowledge of patient care" (G1P1)

"There is a detailed introduction in today's course. For example, when the injection. volume is less than 500 mL every 6 hours, we can continue to use this nutrient pump, to which we did not pay attention before; and there are some tips like headboard elevation" (G2P4)

Due to lack of timely continuing education about pharmacology, participants had misconceptions that needed to be addressed to improve the delivery of care. The VCPE addressed details in patient care, such as the weight loss of patients after surgery , and nutritional problems found in patients who were bedridden for a long time. After participating in the training, these misconceptions were corrected.

"I am a surgical nurse. I used to think that it is normal for patients to lose weight. after surgery. After listening to the lecture, I understood that this is because the nutrition after surgery has not kept up. This is a new understanding. In addition, what the teacher said is (laughs) that simply supplementing patients with amino acids or fat emulsions is a waste of resources and is unscientific if not combined with other nutrients, which is also not comprehensive" (G2P3).

For the most part, speakers from higher-level medical institutions were able to share

more up to date knowledge through video conferences for county-level nursing staff. The knowledge gained broadened nurses' professional horizon and stimulated their interest and motivation to further learn related knowledge.

"*At the beginning, I didn't have a comprehensive understanding of the content of this course, and then through video learning, I got motivated to understand it more deeply and master some basic knowledge" (G1P12)*

"*Teaching some cutting-edge knowledge can broaden our horizons. However, maybe. we don't have so much time to learn by ourselves. We are busy at work and we have to take care of the children. Through tele-education, we are opening up some new horizons and see some new knowledge" (G1P11).*

3.2 Domain two: the shortcomings VCPE

Most participants mentioned that improvements were needed in the VCPE model. The main problem identified by participants was that course content was difficult to understand, especially when they encountered relatively abstract medical indicators, English expressions, or relatively esoteric content.

"*I learned which indicators were used to judge the patient's nutritional status, but. some specific indicators mentioned by the teacher were not easily understood" (G2P12)*

"Many of the guidelines we talked about are in English. The English of our county-level staff is not good, so it is best to translate it into Chinese. Our English level is really not good enough to understand the contents" (G1P9)

"I cannot understand some of the courses. What I heard the most difficult was a. medical course about an electrocardiogram (ECG). Because our hospital carried out projects involving stroke and myocardial infarction, but I didn't understand the ECG course at all" (G1P4)

"I tried hard to understand but still couldn't understand, and there was no chance to. solve the doubts in my mind in time" (G1P9)

Another problem participants noted was about the interaction during lectures. If instructors did not engage in interaction during lectures, the classroom atmosphere appeared to be boring and listeners would have difficulty in understanding the content.

"If the interaction of his video is not good, it will be difficult to understand even though everyone is very interested, the effect will not be good" (G1P8)

"Some questions that were not understood at the time were not asked at the time, and it would be boring without interaction" (G1P12)

Both professional content and clinical content were provided during lectures with a focus on the clinical content. Participants indicated that even though the clinical knowledge had a certain relevance to patient care, overall, there were inadequate courses for nurses.

"Basically everyone can understand nursing classes, but there are relatively few nursing classes. There may be only one class for nursing a month, and sometimes there may be no class for nursing in a whole month" (G1P6)

Under the traditional face-to-face classroom learning model, learners can be more engaged in the content and tend to be more attentive. These factors create an atmosphere

conducive to learning. Compared to this, the VCPE delivery lacked a strong learning atmosphere to engage the learner.

"Compared with studying in the classroom, the biggest disadvantage of this way of learning is that there is no atmosphere" (G2P8)

3.3 Domain three: advantages of the VCPE delivery

Participants emphasized the advantages of the VCPE delivery. The main advantage was convenience, which allowed them to choose the time and the content of study.

"This is a selective learning. For example, if I take a break today, I will come to listen the lecture if I have time. If I have work, I will not come. With this frequency, I think it's good, because every day someone will work and someone will rest, and if they are free, they will come" (G1P7)

"The advantage is that our hospital is now free to choose courses. According to your own time, you can come to listen the lecture you choose if you have time. In every department, there are some nurses not on their duties. According to your own time, you can listen to it even if you are not in this department" (G1P3)

Participating in VCPE does not require distant travels, which significantly saves related travel time and costs.

"*This method does not require you to go to the provincial capital or other big. cities, I can learn it in my own unit. This saves money and time. In the past, it took several days to study in other places. In fact, it would cost a lot of money on travel and accommodation" (G2P3)*

Participants emphasized the importance of learning atmosphere and the learning environment. Some interviewees mentioned that compared with traditional classroom-based learning, the learning atmosphere of VCPE was not strong enough. However, compared with independent online class learning, the learning atmosphere of the VCPE delivery was better.

"Compared with learning online classes alone, this is a better learning atmosphere. If there is a learning atmosphere, everyone wants to learn" (G1P4)

"Ten people are sitting there, nine of them are studying, and the other one who does not want to learn will also start to learn, he will be infected by this atmosphere" (G1P8)

3.4 Domain four: the expectations and suggestions for the VCPE delivery

Participants talked about the learning gains, existing problems, and advantages. On this basis, they put forward specific expectations and suggestions for VCPE delivery. In terms of teaching content, participants mentioned that they hoped to learn pharmaceutical knowledge related to drug infusion, preparation, administration, and preservation in future continuing education.

"Some drugs have a special order (during infusion), but for most departments, it seems no difference in which bottle to infuse first and which bottle to infuse later, I don't quite understand" (G2P12)

"The aciclovir that we used some time ago is quite special. Our doctor's order was to add two vials of medicines to 100ml of saline, but after two vials of medicines were

added, it was impossible to drip, the tube would be blocked and you have to stop dripping (laughs). I really want to know why this happens" (G2P9)

"Our doubt is that some drugs are enteric-coated or slow-released. If we dissolve or crush them, will their effectiveness be affected?" (G2P12)

For teaching content, participants would like to learn about the appropriate use of medications in special populations.

"Especially for pregnant women, sometimes what kind of medicine can be taken when they have a fever. When they are particularly uncomfortable, can they take some antibiotics, can they take cold medicines, and which ones can be taken" (G1P4)

Regarding courseware style, participants mentioned that they hoped that teachers would use actual cases with pictures and texts, and each lecture would not contain too much content.

"It is better to combine with examples, which will impress us deeper. When referring to a case, the lecturer should talk about what was the situation when the patient came, what was used on the first day, just fat emulsion or just amino acids, or two-in-one or three-in-one combination, what was the patient like when they came, and what would happen to them after a week or five days" (G1P9)

"The lecturer had better not talk too much at a time, because listeners cannot remember too much at a time. The lecturer can talk about a few typical cases at a time, and everyone may understand better" (G1P6)

"There are some theoretical knowledge in pharmacy, which is difficult to grasp. The

lecturer had better add a case or picture, which may be more vivid with pictures and texts" (G2P9)

For nurses to better plan their study, interviewees hoped that teachers would communicate learning contents with them in advance.

"If you want to make everyone understand the nursing, you should communicate with the nursing staff in advance. In this way, the lessons you teach may be more acceptable to us" (G1P8)

Another interviewee mentioned that she hoped the lecture content was recorded in the form of videos and stored on the VCPE platform. This would allow nurses to review the video after attending the VCPE sessions.

"Is there that kind of form? Provide us a platform on which we can record courses and click on them anytime after class. In this way, we can learn at home without being restricted by time, place and personnel" (G2P10)

Most interviewees thought that a lecture with a duration of 30 minutes to 40 minutes was more appropriate.

"If the time can be controlled within 30-40 minutes, we think it would be more appropriate. Although the content will be less, we think we can absorb it better after listening" (G1P11)

Finally, concerning teaching style, participants expected teachers to be passionate and create a good learning atmosphere through interactive methods.

"We hope the teacher to be a little bit passionate during the lecture, which can arouse

everyone's enthusiasm and enliven the atmosphere (G2P7).

DISCUSSION

The research team believes this initiative to be the first qualitative study conducted to obtain an understanding of the acceptability of receiving pharmacy education through video conferencing from the perspective of nurses in China. Study results found that the main gains for nursing staff at county-level medical institutions, who attended VCPE sessions, were learning new clinical knowledge and practice pearls. The perceptions, expectations, and suggestions of improvement provide a valuable reference to conduct similar continuing education activities in the future.

As identified in this study, nursing staff can complete continuing education that effectively addresses knowledge gaps and patient care misconceptions through participating in VCPE[12]. This further inspires their learning motivation[12]. Compared with higher-level hospitals, such as provincial hospitals with higher degrees of specialization, the working environment for county-level nurses is more complex requiring more comprehensive mastering of knowledge. These nurses have a great demand for active learning and engagement in continuing education[13]. However, due to remote locations and a lack of educational resources, these nurses have difficulties in accessing face-to face continuing education[14]. For these nurses, VCPE delivered using the hospital tele-medicine platform is a valuable asset for education.

At county-level medical institutions in China, there is a shortage of clinical pharmacists in the institutions[15]. Nurses are required to possess certain level of pharmacy

knowledge without access to the support of a clinical pharmacist to provide patient care. However, obtaining the continuing education needed requires a significant investment in time and money. The problem is especially severe as the workload of nurses in China is relatively heavy given the population size[16]. VCPE allows nurses the flexibility to access learning[12], and it is suitable to fit in the Chinese healthcare system. Nurses can choose courses according to their interests and professional needs. At the same time, interprofessional learning can broaden the horizons of nurses and further stimulate their learning interests[17 18]. Suggestions made by the study participants on video recording of lectures and the improvement of teaching styles can further improve the VCPE delivery allowing nurses who cannot participate in the real-time learning to watch the videos at their convenient times.

This study identified several problem areas that deserve improvement. Firstly, lecturers need to appreciate the learning needs of the county nurses and use a style of presentation that actively engages the learners[19]. The lecturers at higher-level medical institutions are willing to share the latest evidence-based guidelines and diagnosis and treatment standards, which includes how to innovate treatment and nursing care. However, the county-level learners expect that the content of the lectures to be more closely matched to the care demand at the county level. The mismatch of expectations for how to apply the continuing education content and actual content delivery discount the education value[20 21]. The current learning atmosphere of VCPE does not engage the participants in the same manner traditional classroom-style learning, which affects learning. Feedback revealed that

nurses expect teachers to communicate the learning content with them in advance to help them plan and prepare for lectures[22]. Nurses would like teachers to interact with them more often and to have their questions answered in real-time. Nurses want teachers to be passionate during lectures to create a good learning atmosphere[23].

"I don't understand!" and *"How to understand?"* are two statements that this research study prioritized in qualitative content analysis. Regarding the issue of *"I don't understand!"* the following were commented by participants: 1) Certain content of the course were out of touch with the participants' actual practice. Nurses were looking forward to the content of the course, but sometimes felt that they did not know how to apply the course content to practice[24]. 2) There were too many abstract pharmaceutical parameters or clinical indicators in lectures. Nursing staff mentioned that they indeed hope to understand the *in vivo* process of drugs or judge the clinical status of patients through these clinical parameters or indicators[25]. However, due to differences in professional backgrounds, some specific indicators taught by instructors were difficult to understand by nurses. In addition, the nursing staff said that their English was relatively weak. It was difficult for them to understand specific content with more English terms[26]. 3) There was too much content in a lecture. Instructors hoped to deliver more content each time, which made it difficult for participants to understand[27]. 4) The topics of courses were relatively scattered. Therefore, teaching strategies need to be adapted to the learner and the online learning environment.

Participants made a series of suggestions based on *"how to understand?"*, including learning content and teaching methods. The nursing staff clearly mentioned that they were

looking forward to learning more about adverse drug reactions, and issues related to drug infusion, drug preparation and drug administration, pharmacology, drug storage, and medications for special populations[28]. In addition, they hope that the course content should be based on actual cases with pictures and texts[29]. Nursing staff conveyed that their teachers should communicate the content in advance to allow them to choose and prepare beforehand. Nursing staff also hope that lecture content can be made into videos for later reviews. "Passion" and "interaction" are the main expectations that the nursing staff mentioned to the teachers. Passionate lectures can arouse the enthusiasm of learners, enlighten the atmosphere, and make it easier for learners to engage [30 31]. Good classroom interaction can not only promote learners to integrate into the classroom, but also prompt learners to clear their confusions in a timely manner.

This study has the following limitations: 1) The number of subjects was relatively small with participants coming from a single province, Henan, China. However, the study province has a large population and a relatively large number of underserved areas. The province does reflect the development status of China's remote areas. 2) This research only focused on participants' experiences in VCPE and did not explore their experiences in knowledge application to practice and the impact of the application in patients' care. These areas will be studied in the future.

SUMMARY

Compared with the traditional mode of in-person continuing education, video conferencing

pharmacy education delivery to nurses offers convenience, wide accessibility, and savings in time and labor. Organizers should carefully plan course content related to nursing practice and engage in interactive teaching styles.

Contribution statement Z Y, W Z and X D J designed the study and conducted the interviews. X L Y, Y J Z, X Z, P S analyzed the data. X Z and Y L wrote the manuscript. X J Z and S Z D revised the manuscript.

Conflict of Interests All the authors declare that they have no conflict of interest.

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Patient consent for publication Not required.

Ethics approval Ethics was approved by The First Affiliated Hospital of Zhengzhou University Institutional Review Board approved the protocol (2019-KY-304).

Provenance and peer review Not commissioned; externally peer reviewed.

Data statement Data are available on reasonable request. The thematic data that support the findings of this present study are available from the corresponding author on reasonable request.

Figure 1. The whole step of Colaizzi's phenomenological method.
Figure 2. The framework of domains.

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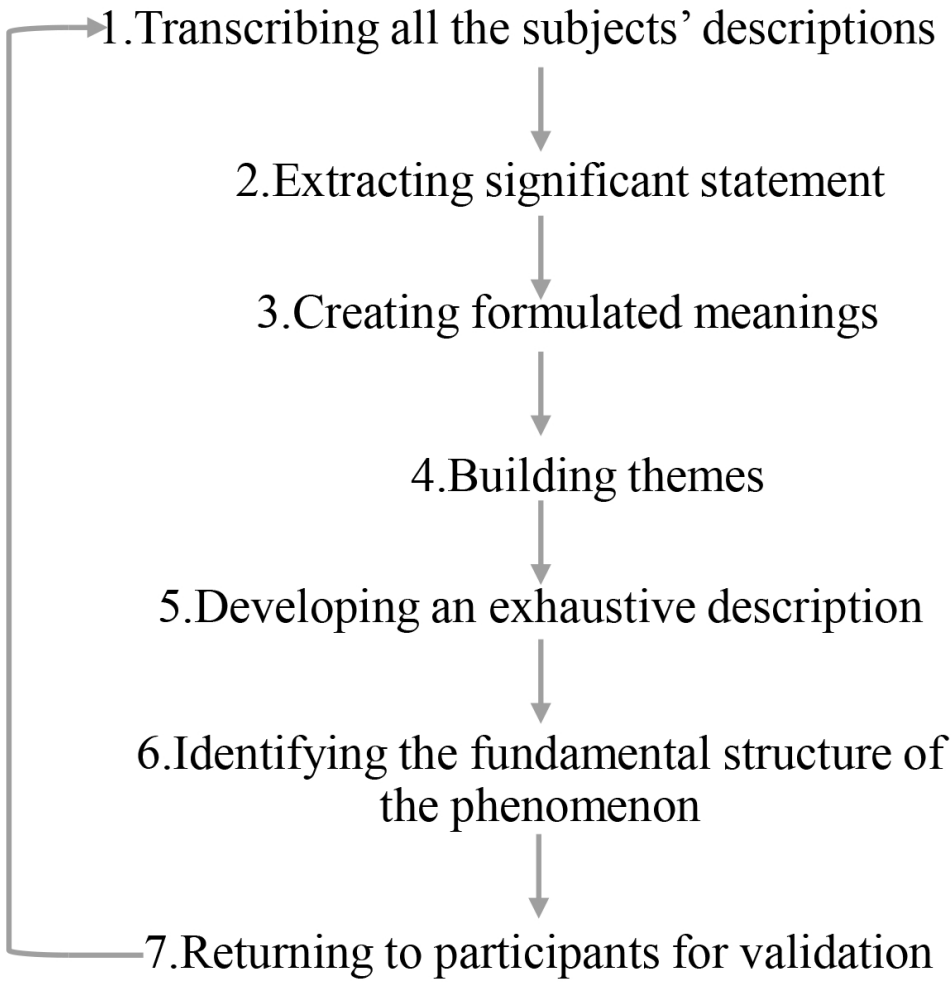
Table1. The demographics of participants (n=23)

Number	Title	Familiarity with VCPE	Expectation of VCPE	Times of partici-pations in VCPE
G1P1	Primary nurse	2	5	3
G1P2	Nurse	5	4	10
G1P3	Primary nurse	3	4	4
G1P4	Primary nurse	5	5	1
G1P5	Nurse	5	5	>10
G1P6	Nurse	3	4	1
G1P7	Senior nurse	5	5	2
G1P8	Nurse	3	5	3
G1P9	Primary nurse	5	5	>10
G1P10	Primary nurse	3	4	5
G1P11	Primary nurse	4	4	>10
G1P12	Primary nurse	4	4	>10
G2P1	Primary nurse	4	3	>10
G2P2	Primary nurse	3	4	1
G2P3	Nurse	3	4	1
G2P4	Nurse	3	5	1
G2P5	Nurse	3	5	1
G2P6	Primary nurse	2	5	1
G2P7	Nurse	2	5	1
G2P8	Nurse	3	5	1
G2P9	Nurse	2	3	1
G2P10	Nurse	2	5	1
G2P11	Nurse	3	4	4

VCPE, Video conference pharmacy education; Familiarity with VCPE (very familiar, 5; familiar, 4; generally familiar,3; not familiar,2; not at all,1) ; Expectation of VCPE (very expected, 5; expected, 4; generally expected,3; not expected,2; not at all,1)



The whole step of Colaizzi's phenomenological method.

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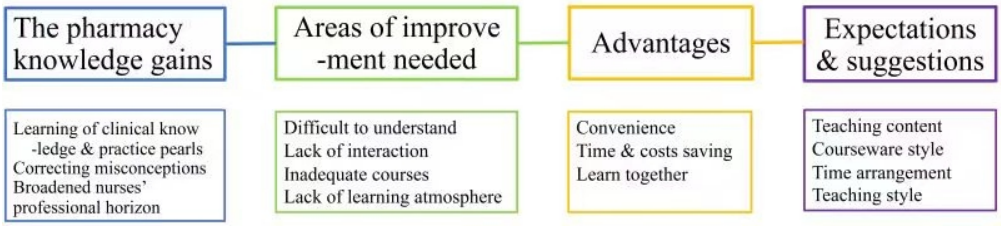

The framework of domains

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SPQR_21items

Item 1. Title: Concise description of the nature and topic of the study. Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended.
Answer：Yes. Stated in page 1, lines 1-2.

Item 2. Abstract: Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions.
Answer：Yes. Stated in pages 1-2, lines 12-33.

Item 3. Problem Formulation: Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement.
Answer：Yes. Stated in page 3-4, lines 48-67.

Item 4. Purpose or research question: Purpose of the study and specific objectives or questions.
Answer：Yes. Stated in page 4, lines 76-80.

Item 5. Qualitative approach and research paradigm: Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., post-positivist, constructivist/interpretivist) is also recommended; rationale
Answer：Yes. Stated in page 4-5, lines 83-85.

Item 6. Researcher characteristics and reflexivity: Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results and/or transferability.
Answer：Yes. Stated in page 5, lines 90-96.

Item 7. Context: Setting/site and salient contextual factors; rationale.
Answer：Yes. Stated in page 7, lines 127-130.

Item 8. Sampling strategy: How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale.
Answer：Yes. Stated in page 7, lines 127-137.

Item 9. Ethical issues pertaining to human subjects: Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack

thereof; other confidentiality and data security issues.
Answer：Yes. Stated in page 4, lines 86-88.

Item 10. Data collection methods: Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale.
Answer：Yes. Stated in page 6, lines 118-120.

Item 11. Data collection instruments and technologies: Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study.
Answer：Yes. Stated in page 6, lines 120-125.

Item 12. Units of study: Number and relevant characteristics of participants, documents, or events included in the study; level of participation.
Answer：Yes. Stated in page 8, lines 158-159. Detailed information of participants is shown in Table 1.

Item 13. Data processing: Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding and anonymization / de-identification of excerpts
Answer：Yes. Stated in page 6, lines 120-124.

Item 14. Data analysis: Process by which inferences, themes, etc. were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale.
Answer：Yes. Stated in page 6. lines 140-147.

Item 15. Techniques to enhance trustworthiness: Techniques to enhance trustworthiness and credibility of data analysis, (e.g., member checking, triangulation, audit trail); rationale
Answer：Yes. Stated in page 8, lines 148-153.

Item 16. Synthesis and interpretation: Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory.
Answer：Yes. Stated in pages 19 to 20, lines 397-401.

Item 17. Links to empirical data: Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings.
Answer：Yes. Stated in “RESULTS” section.

Item 18. Integration with prior work, implications, transferability, and contribution(s) to the field: Short summary of main findings, explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field.
Answer：Yes. Stated in pages 19 to 20, lines 397-401.

Item 19. Limitations: Trustworthiness and limitations of findings
Answer：Yes. Stated in page 19, lines 389-395.

Item 20. Conflicts of interest: Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed.
Answer：Yes. Stated in page 20, line 405.

Item 21. Funding: Sources of funding and other support; role of funders in data collection, interpretation, and reporting.
Answer：Yes. Stated in page 20, line 406.