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Knowledge, attitude and practice of Chinese medical staff in early pulmonary rehabilitation during acute exacerbation of chronic obstructive pulmonary disease: a cross-sectional study

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ABSTRACT

Objective To investigate the knowledge, attitude and practice (KAP) of early pulmonary rehabilitation (PR) of acute exacerbation of chronic obstructive pulmonary disease (AECOPD) among Chinese medical staff and the relationship between them.

Design A multicentre cross-sectional survey was used in this study.

Setting The study was conducted at multiple hospitals in Guizhou Province, China.

Participants A total of 745 medical staff were recruited from several hospitals in Guizhou Province by convenient sampling method.

Primary and secondary outcome measures A 41-item questionnaire was used to collect the demographic characteristics of the respondents and the KAP of the medical staff on the early PR of AECOPD.

Results The average KAP scores were 64.49±17.24, 42.81±5.95 and 41.39±8.97. There were significant positive correlations between knowledge and attitude (r=0.491, p<0.001), knowledge and practice (r=0.129, p<0.001), and attitude and practice (r=0.246, p<0.001). Medical staff with prior PR training and AECOPD early PR experience had higher knowledge and practice scores. Attitudes were significantly influenced by gender, hospital level, professional title and respiratory staff status, while practice scores were significantly affected by prior experience, knowledge and patient contact frequency.

Conclusions The study found that medical staff's knowledge and attitudes affect their practices, and experience and education influence their knowledge. It suggests that organisations should enhance education and training to improve medical staff's knowledge and attitudes, thus enhancing clinical practice. However, the study's focus on Guizhou Province and the high number of nurses in the sample may limit the generalisability of the results.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study is the first of its kind in China to investigate the knowledge, attitude and practice of medical staff on pulmonary rehabilitation of acute exacerbation of chronic obstructive pulmonary disease.
⇒ This study was only conducted in Guizhou Province, China, and the proportion of nurses was high, which affected the universality of the findings.
⇒ All of the data was self-reported by medical staff, which can create inherent bias.
⇒ As with all other cross-sectional studies, the data collection methods in this study capture a single moment, limiting the ability to make causal inferences.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a prevalent and progressive respiratory ailment characterised by persistent airflow obstruction and respiratory symptoms. Despite its heterogeneity, COPD is primarily caused by the inhalation of particulate matter,[1 2] including cigarette smoke and air pollutants, in addition to genetic, developmental and social factors. Furthermore, COPD frequently presents with acute exacerbations, which necessitate additional treatment and pose a significant public health concern in contemporary society.[2–4]

Acute exacerbations are a frequent occurrence among individuals diagnosed with COPD,[5] commonly referred to as acute exacerbation of chronic obstructive pulmonary disease (AECOPD), and have the potential to be severe, leading to hospitalisations and significant healthcare expenditures.[5 6] These exacerbations are a characteristic aspect of the disease and contribute significantly to

both morbidity and mortality rates.[1 7] AECOPD has detrimental effects on patients' overall health and disease progression, rendering them more susceptible to subsequent exacerbations, hospitalisations and even death. Consequently, the primary objective of treatment for patients experiencing AECOPD is to mitigate the adverse consequences associated with these events and prevent their recurrence.[8 9] These exacerbations can also result in further deterioration of quality of life, lung function and functional status, while simultaneously increasing the likelihood of subsequent hospitalisation and premature mortality. AECOPD, defined as an acute event marked by symptom exacerbation necessitating medication adjustment, may expedite disease progression and heighten the susceptibility to hospital admissions and mortality, in addition to diminishing overall quality of life.[10 11]

According to a statement from the American Thoracic Society and the European Respiratory Society, pulmonary rehabilitation (PR) is a comprehensive non-pharmacological treatment that holds the highest potential for enhancing symptoms of COPD; PR serves as a fundamental intervention in the management of patients with stable COPD, encompassing exercise training, education and behavioural modifications.[12 13] While PR programmes are predominantly offered to stable patients or post-discharge, there is a scarcity of training programmes tailored to acute exacerbations during hospitalisation.[10] There exists a substantial body of evidence that substantiates the advantages of PR subsequent to hospitalisation for AECOPD, encompassing enhanced exercise capacity and health-related quality of life, as well as diminished readmissions and mortality rates.[14] Nevertheless, the rates of referral and acceptance for PR remain disappointingly low. Prior data have demonstrated that a mere 30% of eligible patients are referred for PR following hospitalisation, with less than 10% successfully completing the programme. The obstacles impeding referral and acceptance are intricate and multifaceted in nature.[10]

The objective of this study was to examine the knowledge, attitude and practice (KAP) of Chinese medical personnel regarding early PR with AECOPD, as well as to establish the correlation between their KAP in relation to early PR. This exploration of data on medical personnel's KAP and their interrelationships can yield valuable insights for enhancing quality. Researchers have indicated that knowledge has a positive impact on a person's attitude, which in turn affects practice or behaviour,[15] based on which we assumed that the knowledge of medical personnel in PR is directly or indirectly related to practice through attitude.

METHODS

Design and setting

This study employed a multicentre cross-sectional survey to investigate medical staff in various hospitals in Guizhou Province, China, from July to October 2023, using an online questionnaire. The study was guided by the behavioural theory referred to as 'Knowledge-Attitude-Belief Practice (KABP)'.[16] All medical personnel employed in the various hospitals from which data were gathered were deemed eligible for participation through convenience sampling. Convenient sampling may restrict the generalisability of the findings, as the sample might not represent China's entire medical workforce. Self-reported data can also be biased by social expectations, with participants giving socially acceptable rather than genuine responses. To address this, we used a reverse scoring item to identify inconsistencies. Despite these limitations, the study offers valuable insights into the knowledge, attitudes and practices of healthcare workers in Guizhou Province about early PR for AECOPD. The sample size for this cross-sectional study was determined by considering 9 independent variables, 3 questionnaire dimensions and a maximum of 19 items in the scale, resulting in a minimum requirement of 180 participants. To ensure statistical robustness, we aimed for at least 300 participants. Anticipating a 30% response rate,[17] we invited 1000 respondents and received 753 responses. After excluding 8 responses during data processing, 745 responses were included in the final analysis. Figure 1 illustrates the detailed algorithm for sample selection, registration and filtering. In order to be included in the study, these eligible individuals were required to meet two specific criteria: (a) they had to be currently employed in the hospitals for a minimum duration of 1 year and (b) they had to possess a Practice Certificate issued by the Ministry of Health of China. All participants willingly participated in the study, while medical personnel

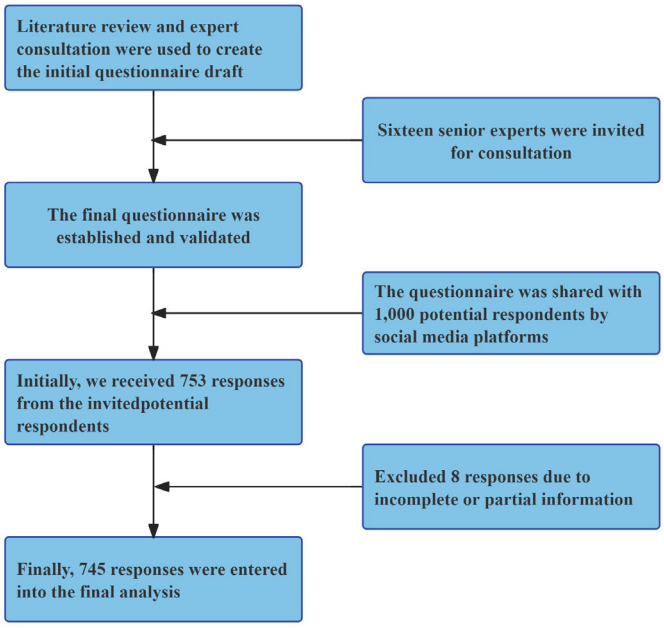

Figure 1 Algorithm showing sample selection, enrolment, exclusion and final analysis. This figure illustrates the flow of participants from initial recruitment to final inclusion in the study. A total of 1000 participants were invited, 753 completed the questionnaire and 745 were included in the final analysis after exclusions.

who did not meet the inclusion criteria were excluded from the study due to the unavailability of an informed consent form.[18] The completion of the questionnaire signifies consent, resulting in a total sample size of 745 instances. To ensure the questionnaire data's quality and validity, each item is designated as a compulsory question, and only the initial response's valid data are chosen based on the IP address and answer time, thereby preventing multiple submissions from a single device. Individuals with a score rate exceeding 85% are classified as excellent and those falling within the 60%–85% range are considered good, while scores below 60% are categorised as poor.

The questionnaires

A structured self-report questionnaire was developed with the purpose of assessing the KAP of medical personnel in relation to early PR for AECOPD. Our decision to employ a self-designed questionnaire encompassing professional knowledge, precautions and operational techniques of PR is believed to provide valuable guidance to medical staff in facilitating patients' engagement in early PR. The design of the questionnaire was executed in two distinct stages. In the initial phase, the research team conducted an extensive literature review to formulate a preliminary version of the questionnaire, which was later refined using the Delphi method. In the subsequent stage, the revised document will be subjected to expert scrutiny, ultimately leading to the creation of the final questionnaire. The questionnaire encompassed three distinct dimensions, namely knowledge (comprising 19 items), attitude (comprising 11 items) and practice (comprising 11 items). The knowledge dimension of this study primarily focused on the definition, main contents, curative effect, contraindications, implementation period and principles of PR. Participants were asked to rate their level of understanding on a 5-point Likert scale ranging from 'Very little' to 'Very well'. The attitude dimension, on the other hand, assessed participants' perceptions of the impact of PR, role perception and management of AECOPD in clinical practice. This dimension also used a 5-point Likert scale, ranging from 'Strongly disagree' to 'Strongly agree'. The 'practice' dimension focuses on early PR actions and skills in AECOPD, such as (1) evaluating patient eligibility for early PR, (2) implementing PR methods like breathing exercises and physical training, (3) tracking patient progress in PR, and (4) providing PR benefits and technical education. Each aspect is rated on a 5-point Likert scale from 'not willing' to 'willing'. To mitigate the risk of subjects completing the questionnaire in a careless manner and to minimise the occurrence of invalid responses, we employed a strategy of incorporating reverse questions within the first five items of the attitude dimension. The content validity of the questionnaire was evaluated by a panel of 16 local experts who fulfilled the following criteria: (1) possessing expertise in critical care, nursing management, nursing research, respiratory specialist nursing or respiratory department; (2) holding academic titles of associate chief senior nurse/doctor, associate professor or higher; and (3) affiliated with tertiary hospitals or medical colleges. Following two rounds of expert reviews and subsequent modifications, the Cronbach's α coefficient and Kaiser-Meyer-Olkin value of the final PR scale were determined to be 0.953 and 0.969, respectively. Overall, the questionnaire exhibited acceptable levels of validity and reliability within the context of this study.

Data collection and ethical considerations

It is important to note that participation in the study was entirely voluntary. To gather data, web-based questionnaires were employed, with the design and creation of the questionnaire link being entrusted to Questionnaire Star (Changsha Ranxing Information Technology Co. Ltd). Data will be gathered via the facilitation of a WeChat group. Upon completion of the questionnaire, respondents are required to click the 'Submit' button to save their responses. Additionally, participants will not be provided with any financial compensation upon completing the questionnaire. The questionnaires were designed to be anonymous, and no personal information related to medical personnel will be collected, thereby ensuring that respondents' identities remain unlinked and confidential.

Data analysis

In this study, IBM SPSS V.27.0 for Windows was used for statistical analysis. To ensure the robustness of the statistical analysis, we performed a normality test (Shapiro-Wilk) for all continuous variables. Descriptive information was presented as n (%) or mean±SD. The calculation of score percentages for both overall and individual dimensions involved dividing the average score by the theoretical maximum and multiplying by 100%. Certain continuous variables, such as age and number of years of hospitalisation experience, were categorised into distinct groups for analysis. In order to examine the disparities between the scale and demographic information, we employed an independent-sample t-test and a one-way analysis of variance (ANOVA). In the case of the t-test, if both samples meet the assumption of equal variance, the t-test of equal variance is used. Conversely, if the variances are unequal, a t-test for unequal variances is employed. The Tukey test was employed to conduct group comparisons. The examination of the association between KAP entailed the utilisation of Pearson correlation coefficients. To examine the factors influencing KAP, we employed multiple linear regression analysis, adjusting for potential confounders including age, years of experience and hospital classification to ensure the robustness of our results. Bilateral significance tests were conducted for all analyses, with the significance threshold established at 0.05.

Patient and public involvement

No patient is involved.

RESULTS

Sociodemographic characteristics of participants

Out of 1000 invited participants, 753 medical staff completed the questionnaire, yielding 745 valid responses. This results in a 75.3% response rate and a 98.9% validity rate. The majority of participants were female (680, 91.3%) and predominantly occupied nursing roles (684, 91.8%). Among the respondents, 334 primarily worked in the tertiary hospitals, while the remaining 409 were affiliated with secondary hospitals, accounting for 54.9% of the sample. Furthermore, a significant proportion of participants held a bachelor's degree or higher (566, 76%). Approximately 43.9% of the participants had undergone early PR training for AECOPD, while a similar proportion (42.7%) had practical experience in AECOPD early PR work. Further comprehensive details regarding the sociodemographic and professional characteristics can be found in table 1.

Table 1 Sociodemographic characteristics

Socio-demographic variables	N (%)
Gender	
Male	65 (8.7)
Female	680 (91.3)
Age	
20–29	352 (47.2)
30–39	329 (44.2)
Above 40	64 (8.6)
Education	
Postgraduate or above	5 (0.7)
Bachelor degree	561 (75.3)
Three-year college education	174 (23.3)
Secondary vocational school education	5 (0.7)
Occupation	
Doctor	61 (8.2)
Nurse	684 (91.8)
Years of working	
1–5	221 (41.9)
5–9	254 (31.9)
Above 10	270 (26.2)
The title of a professional post	
Junior professional title	462 (62.0)
Medium-grade professional title	251 (33.7)
Associate senior title	26 (3.5)
High professional title	6 (0.8)
Hospital level	
Tertiary hospitals	334 (44.8)
Second-class hospital	409 (54.9)
Class-I hospital	2 (0.3)
Receive training	
Yes	327 (43.9)
No	418 (56.1)
Work experience	
Yes	318 (42.7)
No	417 (57.3)

The level of KAP of medical staff towards AECOPD pulmonary rehabilitation

The average knowledge score was 64.49±17.24, corresponding to a scoring rate of approximately 68%. Likewise, the average attitude score was 42.81±5.95, indicating a scoring rate of around 77%. Furthermore, the average attitude score was 41.39±8.97, with a scoring rate of about 75%. Detailed analysis results for each dimension are provided in table 2.

Effects of demographic and job-related variables on healthcare workers' KAP towards pulmonary rehabilitation for AECOPD

Knowledge

The findings from the one-way ANOVA presented in table 2 indicate significant variations in knowledge scores across various departments. Additionally, significant differences in knowledge scores were observed when comparing different frequencies of contact with patients. However, no significant relationship was found between age, education level, working time, professional title, hospital level, position and knowledge. Based on the results of the independent-sample t-test, significant variations in knowledge scores were identified among distinct categories, including gender, occupation, presence of work experience in early PR of AECOPD, participation in training related to early PR of AECOPD, familiarity with relevant knowledge, and employment as respiratory department staff. Based on the findings of Tukey's test, it was observed that knowledge scores in various departments such as stomatology, gynaecology and ENT, among others, exhibited significant disparities when compared with the scores in emergency, internal medicine and ICU. Furthermore, variations in knowledge scores were also evident across different levels of patient interaction, specifically within the ranges of 0–9%, 10%–29% and ≥30%.

Attitude

Based on the findings from the independent-sample t-test and one-way ANOVA, significant statistical disparities were observed across various demographic variables, including gender, age, occupation, years of work, title, position, hospital level, experience in AECOPD PR work, familiarity with AECOPD PR knowledge, department affiliation and respiratory staff status. Based on the findings of Tukey's test, a notable disparity in attitude scores was observed between individuals aged 20–29 and those aged ≥40. Furthermore, significant variations were identified in the scores of individuals with work experience of ≥10 years compared with those with work experience of 5–9 years and ≤5 years.

Table 2 The knowledge, attitude and practice score

Variables	Knowledge		Attitudes		Practices	
	Mean±SD	Test results	Mean±SD	Test results	Mean±SD	Test results
Gender						
Male	70.49±15.97	t'=3.146	40.94±7.11	t'=−2.251	42.94±8.02	t=1.454
Female	63.92±17.26	**p=0.002**	42.99±5.80	**p=0.027**	41.25±9.05	p=0.146
Age						
20–29	64.82±15.98	F=0.121	42.14±5.80	F=5.164	41.05±8.49	F=0.620
30–39	64.22±18.28	p=0.886	43.24±5.93	**p=0.006**	41.60±9.40	p=0.538
Above 40	64.11±18.68		44.30±6.46		42.23±9.40	
Education						
Postgraduate or above	81.80±10.94	F=1.754	42.60±4.98	F=0.715	41.20±7.73	F=0.608
Bachelor degree	64.51±17.54	p=0.155	42.97±6.08	p=0.543	41.64±9.05	p=0.610
Three-year college education	63.93±16.17		42.35±5.53		40.65±8.76	
Secondary vocational school education	65.60±20.66		40.60±5.37		39.60±9.92	
Occupation						
Doctor	73.90±15.72	t'=4.814	44.28±9.41	t=2.631	39.36±6.65	t=−4.794
Nurse	63.65±17.13	**p < 0.001**	41.14±8.90	**p=0.009**	43.12±5.80	**p < 0.001**
Years of working						
1–5	65.92±15.39	F=1.177	42.33±5.84	F=7.063	41.03±8.23	F=2.764
5–9	63.54±17.59	p=0.309	42.09±5.90	**p < 0.001**	40.65±8.90	p=0.064
Above 10	64.23±18.31		43.88±5.95		42.40±9.57	
The title of a professional post						
Junior professional title	64.50±16.75	F=1.396	42.12±5.74	F=5.78	40.98±8.65	F=0.930
Medium-grade professional title	65.18±17.72	p=0.243	44.04±6.19	**p < 0.001**	42.15±9.40	p=0.426
Associate senior title	57.92±20.71		42.96±5.67		41.46±10.52	
High professional title	64.00±16.96		43.17±5.31		41.50±8.19	
Hospital level						
Tertiary hospitals	64.94±17.09	F=0.267	43.36±6.15	F=3.131	41.10±9.26	F=0.614
Second-class hospital	64.11±17.32	p=0.766	42.38±5.75	**p=0.044**	41.61±8.74	p=0.541
Class-I hospital	68.50±36.06		38.00±2.83		46.50±12.02	
Receive training						
Yes	73.72±12.76	t'=15.162	43.29±6.46	t'=1.912	43.84±8.41	t'=6.803
No	57.27±16.86	**p < 0.001**	42.43±5.49	p=0.056	9.48±8.95	**p < 0.001**
Work experience						
Yes	74.03±12.35	t'=15.488	43.47±6.54	t'=2.544	44.15±8.27	t'=7.586
No	57.40±16.96	**p < 0.001**	42.32±5.42	**p=0.011**	39.34±8.94	**p < 0.001**
Understand relevant knowledge						
Yes	73.10±12.81	t'=18.500	43.33±6.54	t'=2.876	43.82±8.42	t=8.902
No	53.19±15.75	**p < 0.001**	42.12±5.00	**p=0.04**	38.20±8.70	**p < 0.001**
Hospital position						
General staff	64.48±17.11	F=0.118	42.56±5.89	F=7.021	41.40±8.88	F=1.554
Head nurse	64.24±19.35	p=0.889	45.56±6.06	**p < 0.001**	40.53±9.96	p=0.212
Head of department	67.38±14.85		44.75±5.20		46.50±9.34	
Department						
Internal medicine	68.72±16.10	F=22.752	43.32±6.36	F=2.429	42.57±8.70	F=4.810
Department of surgery	58.01±16.86	**p < 0.001**	41.57±5.19	**p=0.046**	39.60±9.31	**p < 0.001**
Emergency treatment	65.11±15.86		42.34±5.04		41.63±7.99	

Continued

Table 2 Continued

Variables	Knowledge		Attitudes		Practices	
	Mean±SD	Test results	Mean±SD	Test results	Mean±SD	Test results
Intensive care unit	70.53±12.01		43.34±6.42		41.91±7.31	
Other	55.94±17.73		42.36±5.26		39.39±9.71	
Respiratory staff						
Yes	73.42±13.64	t'=12.664	43.84±6.92	t'=3.468	43.60±8.52	t=5.330
No	59.09±16.96	**p < 0.001**	42.18±5.18	**p < 0.001**	40.05±8.99	**p < 0.001**
Patient contact frequency						
0–9%	52.70±17.65	F=83.310	42.12±5.23	F=1.536	37.92±9.33	F=19.301
10%–29%	62.88±16.33	**p < 0.001**	42.96±5.77	p=0.216	41.63±8.71	**p < 0.001**
Above 30%	71.10±14.05		43.05±6.35		42.93±8.51	

The bold data indicate values where p<0.05, which represent statistically significant results.
t', t-tests for unequal variances.

Practice

The results of the independent-sample t-test indicated significant relationships between occupation, participation in AECOPD PR training, relevant work experience, knowledge and being a respiratory staff member with practice. However, the one-way ANOVA revealed that only the department of the subjects and the frequency of patient contact were significantly associated with practice, while the other variables did not demonstrate statistical significance. Based on the findings of Tukey's test, a statistically significant disparity was observed in the practice scores among patients with varying frequencies of contact, specifically those scoring between 10 to 29%, ≥30%, and 0–9%.

Correlation study of KAP of medical staff on PR in patients with AECOPD

The findings of the correlation analysis are presented in table 3, indicating a notable and positive correlation between knowledge and attitudes (r=0.491, p<0.001). As the knowledge score increased, there was a corresponding elevation in attitude scores. Additionally, a significant and evident correlation between knowledge and practice was observed, with a statistically significant relationship (r=0.129, p<0.001). Furthermore, a strong correlation between attitude and practice was clearly evident (r=0.246, p<0.001).

Results of several linear regression equations

Statistically significant variables in univariate analyses were added to multivariate linear stepwise regression. An analysis was conducted employing multiple linear regression equations to explore the independent associations between KAP scores. The findings from the multiple linear regression model online supplemental table 1 revealed significant associations between knowledge and variables such as training received, AECOPD early PR work experience, familiarity with relevant knowledge, occupation as respiratory staff, and frequency of patient contact. After accounting for other variables, the analysis presented in online supplemental table 2 demonstrates that gender, hospital level, professional title and various positions within the respiratory staff are independent factors that significantly impact attitudes. Furthermore, the presence of prior AECOPD early PR work experience, knowledge pertaining to the subject matter, and frequency of contact with AECOPD patients were identified as independent factors influencing practice scores, as indicated in online supplemental table 3.

Table 3 Correlation of knowledge, attitude and practice related to early pulmonary rehabilitation from acute exacerbation of chronic obstructive pulmonary disease of medical staff

	Scores of knowledge	Scores of attitude	Scores of practice
Scores of knowledge			
Pearson correlation	1	0.491**	0.129**
Sig.		**0.000**	**0.000**
N	745	745	745
Scores of attitudes			
Pearson correlation	0.491**	1	0.246**
Sig.	**0.000**		**0.000**
N	745	745	745
Scores of practices			
Pearson correlation	0.129**	0.246**	1
Sig.	**0.000**	**0.000**	
N	745	745	745

**Correlation is significant at the 0.01 level (2-tailed)
The bold data indicate values where p<0.05, which represent statistically significant results.

DISCUSSION

AECOPD has been found to have a substantial negative impact on quality of life and an elevated risk of mortality.[19] Existing guidelines strongly advocate for the implementation of early PR following a severe exacerbation.[12] Recent research has additionally demonstrated the advantages of early PR during hospitalisation for the management of AECOPD, highlighting its safety and reliability.[5 20] The objective of this study was to evaluate the level of KAP among medical personnel regarding early PR for AECOPD. Our findings indicate that medical staff in the Guizhou region of China demonstrate promising KAP towards early PR for AECOPD. However, there is a need for improvement in the KAP of nurses in this area. Additionally, our study revealed a significant correlation between KAP scores for early PR in AECOPD. This finding aligns with previous research, indicating the necessity for further enhancement of PR education programmes within our nation.[20] Additionally, it is evident that a majority of medical professionals, particularly nurses, possess a general comprehension of the field of PR, yet their knowledge lacks depth and comprehensiveness. However, Chinese scholars are actively endeavouring to address this phenomenon. Presently, studies pertaining to the PR management mode, spearheaded by respiratory specialist nurses, demonstrate the noteworthy long-term impact of multispecialist group collaboration in PR led by specialist nurses.[21 22] This not only influences patient prognosis but also holds immense significance for the advancement of Chinese medical personnel in the realm of PR.

A thorough understanding and recognition of early PR among healthcare professionals are imperative for attaining favourable outcomes in patients with AECOPD, as it serves as the foundation for adopting suitable attitudes and practices.[23] The present study revealed that the rate of knowledge pertaining to early PR was approximately 68%, with an average knowledge score of 64.49±17.24. These findings suggest that medical personnel possess inadequate knowledge regarding early PR, aligning with the research outcomes reported by Chinese scholars Su *et al*.[24] Among the items assessed, PR programmes and prognostic and curative knowledge received the highest average scores, in that order. Conversely, the content of PR, the scale of assessment, and the related knowledge of the principles followed obtained the lowest average scores. These findings indicate that while medical staff possess a general understanding of early PR, their knowledge lacks comprehensiveness and depth. Currently, the most recent research demonstrates the efficacy and safety of early PR treatment for AECOPD.[5 25–27] The field of medicine encompasses various components, including daily diagnosis, treatment and health service support, all of which heavily rely on the involvement of nurses.[28] Consequently, the nursing workload is substantial and demanding. Particularly, due to factors such as limited nursing staff and the ratio of medical personnel, there is a scarcity of healthcare providers during rotation tasks, resulting in a primary focus on routine treatment and disease management.[29] The inability to promptly and comprehensively update the most recent knowledge and skills necessitates the need for further standardisation of the rotation system for medical personnel, scientific innovation in nursing scheduling methods, and rational establishment of the medical care ratio.[30] Furthermore, telemedicine presents potential benefits in mitigating disease symptoms,[31] particularly when integrated with educational initiatives, self-management strategies (including swallowing training, the gradual reintegration into physical activity, food texture modification and psychological support), and physical exercise.

In the present study, the attitude dimension score rate among medical staff was approximately 77%, with an average score of 42.81±5.95. Not exactly consistent with previous studies, the study conducted by Guo *et al* revealed that a considerable percentage of nurses (86%) recognised the significance of PR in the care of individuals diagnosed with COPD.[32] Johnston *et al* reported that 77% of healthcare professionals expressed a strong belief in the utmost importance of PR for COPD patients.[33] The observed outcome may be attributed to variations in hospital level and specific departments. Findings from this investigation indicate a statistically significant elevation in the attitude score among medical personnel in tertiary hospitals compared with those in primary hospitals ($p=0.044$). Furthermore, medical staff working in the respiratory department exhibited significantly higher attitude scores in comparison to their counterparts in other departments ($p<0.001$). Previous research has demonstrated that the educational background of nursing staff with limited experience and junior positions in primary hospitals in China tends to be subpar.[34] Currently, clinical nursing staff exhibit a low and heterogeneous level of scientific research proficiency. It is imperative for nursing managers to implement systematic training programmes that enhance nurses' knowledge and practical skills in scientific research within the field of nursing.[35] Evidently, substantial evidence supports the notion that knowledge significantly impacts attitudes.

In the present study, the practice dimension of medical staff yielded a score rate of approximately 75%, with an average score of 41.39±8.97. These findings suggest that the overall performance of medical staff in implementing PR is commendable. However, it should be noted that these results do not align entirely with the study conducted by Guo *et al*.[32] Following extensive research, early PR for COPD has yielded significant outcomes, establishing its status as a secure and efficacious non-pharmacological intervention. Similarly, AECOPD early PR builds upon the advancements in COPD early PR and is likewise acknowledged as a reliable and effective non-pharmacological treatment. Only 25.9% of the population achieved a scoring rate of no less than 85%, while 48.9% of the population achieved a scoring rate between 60% and 85%. Notably, the three areas with the lowest scores were the mastery of accident cause analysis, the ability to organise patients in learning relevant content, and the proficiency in assessment techniques. However,

it is worth noting that a subset of medical personnel exhibited suboptimal scores, potentially attributable to the limited sample pool used in this study. A significant majority of the samples were derived from level I and level II hospitals, suggesting a plausible explanation for the lack of standardised training among a considerable portion of healthcare providers.[36] Consequently, the inability to deliver tailored and proficient treatment and care to patients undergoing PR may be a consequence of this deficiency.

The findings of this study indicate significant positive associations between KAP ($p<0.01$). This finding suggests that a higher level of PR knowledge among medical personnel is associated with the ability to cultivate a positive attitude and enhance behavioural compliance. It is evident that a causal relationship exists between knowledge, belief and action, aligning with the theoretical framework positing that knowledge influences attitude, which in turn drives behaviour. The medical staff in the respiratory department assumes a crucial role as the primary executors of PR training for patients with AECOPD. Extensive research has demonstrated that a deeper understanding of PR among medical staff correlates positively with their ability to enhance patients' motivation and adherence to the programme.[37] Ballesteros Reviriego *et al*[38] demonstrated that early physical therapy enhances lung function and muscle strength without adverse effects, influencing both clinical practice and policy. The study found that better knowledge, attitudes and practices among healthcare workers, through targeted education, can boost their participation and confidence in implementing early PR for AECOPD. This may result from a better grasp of PR principles, enhanced patient assessment skills and more effective clinical decisions. Hospitals can offer regular workshops or online courses on early PR techniques. Policymakers might also integrate early PR training into ongoing education for healthcare professionals, particularly in resource-limited areas with limited access to specialised training. These initiatives can enhance knowledge and attitudes, leading to improved clinical practices and patient outcomes.

Through the utilisation of multiple linear regression analysis, our study revealed a significant correlation between knowledge and various factors, including training, prior experience in AECOPD PR, comprehension of relevant knowledge, occupation as respiratory workers, and frequency of patient interaction. The findings of this study suggest that medical personnel who have received training in PR and possess work experience in this field demonstrate superior levels of knowledge and practice. These results indicate that practical experience in clinical settings can enhance one's understanding, abilities and confidence in the context of PR, aligning with previous research findings.[39] The findings of the survey conducted by Mahendran *et al* on PR among nurses indicate that participation in training courses and gaining clinical experience have the potential to enhance nurses' KAP.[40] Engagement in PR training and relevant professional experience can enhance the knowledge and proficiency of healthcare personnel, thereby influencing the clinical advancement of PR.

The study has limitations: its cross-sectional design prevents establishing causality between knowledge, attitudes and practice, necessitating longitudinal studies or trials. Self-reported data may introduce social expectation bias, suggesting the need for observational measures in future research. Additionally, the sample, primarily nurses from Guizhou Province, may limit the findings' generalisability to other regions or medical professionals. Future research should include a more diverse sample to enhance external validity and address potential confounding factors like experience, education and hospital class. While some factors were controlled in our analysis, unmeasured variables may influence outcomes. Collecting comprehensive data on these elements could clarify their impact on early PR-related knowledge, attitudes and practices in AECOPD.

CONCLUSIONS

This study examines the KAP of Chinese medical staff in Guizhou Province regarding early PR for AECOPD. While attitudes towards early PR are generally positive, there are gaps in knowledge and practical application. The study finds strong positive correlations between knowledge, attitudes and practices, indicating that better education and training could improve clinical outcomes. Medical staff with prior PR training and experience scored higher in knowledge and practice, highlighting the need for ongoing education and hands-on experience. However, the study's focus on one region and a high number of nurses limits its generalisability. To enhance early PR for AECOPD, healthcare organisations should prioritise education, encourage positive attitudes and provide clinical exposure to improve patient care. Future research should involve more diverse samples and longitudinal studies to explore these relationships further.

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REFERENCES

1 Sadatsafavi M, McCormack J, Petkau J, *et al*. Should the number of acute exacerbations in the previous year be used to guide treatments in COPD? *Eur Respir J* 2021;57:2002122.
2 Zhang D, Zhang H, Li X, *et al*. Pulmonary Rehabilitation Programmes Within Three Days of Hospitalization for Acute Exacerbation of Chronic Obstructive Pulmonary Disease: A Systematic Review and Meta-Analysis. *Int J Chron Obstruct Pulmon Dis* 2021;16:3525–38.
3 Christenson SA, Smith BM, Bafadhel M, *et al*. Chronic obstructive pulmonary disease. *Lancet* 2022;399:2227–42.
4 Machado A, Matos Silva P, Afreixo V, *et al*. Design of pulmonary rehabilitation programmes during acute exacerbations of COPD: a systematic review and network meta-analysis. *Eur Respir Rev* 2020;29:200039.
5 Moecke DP, Zhu K, Gill J, *et al*. Safety and Efficacy of Inpatient Pulmonary Rehabilitation for Patients Hospitalized with an Acute Exacerbation of Chronic Obstructive Pulmonary Disease: Systematic Review and Meta-analyses. *Ann Am Thorac Soc* 2023;20:307–19.
6 Galerneau L-M, Bailly S, Terzi N, *et al*. Management of Acute Exacerbations of Chronic Obstructive Pulmonary Disease in the ICU: An Observational Study From the OUTCOMEREA Database, 1997-2018. *Crit Care Med* 2023;51:753–64.
7 Machado A, Barusso M, De Brandt J, *et al*. Impact of acute exacerbations of COPD on patients' health status beyond pulmonary function: A scoping review. *Pulmonology* 2023;29:518–34.
8 Li SQ, Sun XW, Zhang L, *et al*. Impact of insomnia and obstructive sleep apnea on the risk of acute exacerbation of chronic obstructive pulmonary disease. *Sleep Med Rev* 2021;58:101444.
9 Sim YS, Lee JH, Lee EG, *et al*. COPD Exacerbation-Related Pathogens and Previous COPD Treatment. *J Clin Med* 2022;12:111.
10 Barker RE, Kon SS, Clarke SF, *et al*. COPD discharge bundle and pulmonary rehabilitation referral and uptake following hospitalisation for acute exacerbation of COPD. *Thorax* 2021;76:829–31.
11 Ibrahim W, Harvey-Dunstan TC, Greening NJ. Rehabilitation in chronic respiratory diseases: In-hospital and post-exacerbation pulmonary rehabilitation. *Respirology* 2019;24:889–98.
12 Guecamburu M, Coquelin A, Rapin A, *et al*. Pulmonary rehabilitation after severe exacerbation of COPD: a nationwide population study. *Respir Res* 2023;24:102.
13 Tung L-F, Shen S-Y, Shih H-H, *et al*. Effect of high-flow nasal therapy during early pulmonary rehabilitation in patients with severe AECOPD: a randomized controlled study. *Respir Res* 2020;21:84.
14 Meneses-Echavez JF, Chavez Guapo N, Loaiza-Betancur AF, *et al*. Pulmonary rehabilitation for acute exacerbations of COPD: A systematic review. *Respir Med* 2023;219:107425.
15 Bettinghaus EP. Health promotion and the knowledge-attitude-behavior continuum. *Prev Med* 1986;15:475–91.
16 Schuster A, Randrianasolo BS, Rabozakandraina OO, *et al*. Knowledge, experiences, and practices of women affected by female genital schistosomiasis in rural Madagascar: A qualitative study on disease perception, health impairment and social impact. *PLoS Negl Trop Dis* 2022;16:e0010901.
17 Ahmed I, Ether SA, Saha P, *et al*. Knowledge, attitude and practices towards SARS-CoV-2 genetic mutations and emerging variants among the population in Bangladesh: a cross-sectional study. *BMJ Open* 2023;13:e073091.
18 Yao L, Li Y, Wang T, *et al*. Chinese medical staff's knowledge, attitudes and practices towards breast cancer patients' sexual health management: A cross-sectional study. *Heliyon* 2023;9:e19701.
19 Yu H, Lei T, Su X, *et al*. A systematic review and Bayesian meta-analysis of the antibiotic treatment courses in AECOPD. *Front Pharmacol* 2023;14:1024807.
20 Luo G. Current status and analysis of the development of pulmonary rehabilitation nursing in China. 2022.
21 Wang R, Lu J, Guo X, *et al*. Application research of multi-specialty group cooperative pulmonary rehabilitation management mode led by respiratory specialist nurses in patients with AECOPD. *J Nurs Train* 2021;23:2149–54.
22 He B, Yang Z, Mo B, *et al*. Study on the construction of a nurse-led pulmonary rehabilitation management program and its application to ventilator-dependent patients in ICU. *Chin J Nurs* 2023;58:1802–8.
23 Hagos WG, Muchie KF, Gebru GG, *et al*. Assessment of knowledge, attitude and practice towards rabies and associated factors among household heads in Mekelle city, Ethiopia. *BMC Public Health* 2020;20:57.
24 Su L, Wang L, Ding J, *et al*. Knowledge, attitudes and practices regarding pulmonary rehabilitation among patients with chronic respiratory diseases: a cross-sectional questionnaire-based study in a tertiary hospital in China. *BMJ Open* 2025;15:e085944.
25 Lu H-Y, Chen C-F, Lee DL, *et al*. Effects of Early Pulmonary Rehabilitation on Hospitalized Patients with Acute Exacerbation of Chronic Obstructive Pulmonary Disease: A Systematic Review and Meta-Analysis. *Int J Chron Obstruct Pulmon Dis* 2023;18:881–93.
26 Corbellini C, Rossino E, Massaccesi R. Improvements in Perimeter thoracic mobility on patients with COPD after pulmonary rehabilitation: a case series. *Electron J Gen Med* 2022;19:em361.
27 Aldhahir AM, Alqahtani JS, AlDraiwiesh IA, *et al*. Healthcare providers' attitudes, beliefs and barriers to pulmonary rehabilitation for patients with chronic obstructive pulmonary disease in Saudi Arabia: a cross-sectional study. *BMJ Open* 2022;12:e063900.
28 Kleve L, Vårdal L, Elgen IB. The Nurse Role in the Management of ADHD in Children and Adolescent: A Literature Review. *Front Psychiatry* 2022;13:676528.
29 M Q. Status Quo of Nursing in an Island hospital and its inspiration for nursing and medical support. *Military Nursing* 2021;38:87–9.
30 Chen S, Lin Z, Fan X, *et al*. The Comparison of Various Types of Health Insurance in the Healthcare Utilization, Costs and Catastrophic Health Expenditures among Middle-Aged and Older Chinese Adults. *Int J Environ Res Public Health* 2022;19:5956.
31 Martínez-Pozas O, Corbellini C, Cuenca-Zaldívar JN, *et al*. Effectiveness of telerehabilitation versus face-to-face pulmonary

rehabilitation on physical function and quality of life in people with post COVID-19 condition: a systematic review and network meta-analysis. *Eur J Phys Rehabil Med* 2024;60:868–77.
32 Guo S-E, Shen H-C, Okoli C, *et al*. Generalist versus specialist nurses' knowledge, attitudes, and behavioral intentions toward promoting pulmonary rehabilitation for patients with chronic obstructive pulmonary disease: A cross-sectional correlational study. *Medicine (Baltimore)* 2018;97:e12975.
33 Johnston CL, Maxwell LJ, Maguire GP, *et al*. How prepared are rural and remote health care practitioners to provide evidence-based management for people with chronic lung disease? *Aust J Rural Health* 2012;20:200–7.
34 Li C, Shi C. Adverse Events and Risk Management in Residential Aged Care Facilities: A Cross-Sectional Study in Hunan, China. *Risk Manag Healthc Policy* 2022;15:529–42.
35 G Y. Investigation and analysis of scientific research ability of nurses in charge or nursing staff with bachelor degree or above in a second class A hospital. *Modern Nurse* 2018;29:29–32.
36 Incollingo Rodriguez AC, Smieszek SM, Nippert KE, *et al*. Pregnant and postpartum women's experiences of weight stigma in healthcare. *BMC Pregnancy Childbirth* 2020;20:499.
37 Tang CY, Taylor NF, McDonald CF, *et al*. Level of adherence to the GOLD strategy document for management of patients admitted to hospital with an acute exacerbation of COPD. *Respirology* 2014;19:1191–7.
38 Ballesteros Reviriego G, Planas Pascual B, Rojo Ruiz A, *et al*. Spanish experience of pulmonary rehabilitation efficacy for patients affected by the novel SARS-CoV-2 (COVID-19). *Top Geriatr Rehabil* 2020;36:212–4.
39 Roha YS, Lima EJ, Issenberg SB. Effects of an integrated simulation-based resuscitation skills training with clinical practicum on mastery learning and self-efficacy in nursing students. *Collegian* 2016;23:53–9.
40 Mahendran R, Chua J, Peh CX, *et al*. Knowledge, attitudes, and practice behaviors (KAPb) of nurses and the effectiveness of a training program in psychosocial cancer care. *Support Care Cancer* 2014;22:2049–56.