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Physical Therapist's knowledge, attitude and practices in in-patient physiotherapy Treatment for primary ciliary dyskinesia: A cross-sectional study

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Abstract

Primary ciliary dyskinesia (PCD) is a rare hereditary multisystem disorder characterized by defective motile cilia that can adversely affect organogenesis, fertility, and mucociliary clearance. Physiotherapists (PTs) play a vital role in supporting patients with chronic conditions by promoting physical rehabilitation and overall well-being; therefore, it is essential that PTs deliver inpatient physiotherapy in accordance with established guidelines to mitigate the serious consequences associated with PCD. This study aimed to assess the knowledge, attitudes, and practices of physical therapists managing PCD in inpatient settings. A self-administered questionnaire comprising five sections covering demographics, knowledge of PCD, attitudes, best practice implementation, and barriers to PCD management was administered to physiotherapists employed in Lahore, Punjab, Pakistan. Among the participants, 84.9% correctly identified postural drainage and chest physiotherapy as essential airway clearance techniques, while 46.7% demonstrated adequate knowledge of PCD. Despite 95.2% adhering to conventional management protocols for uncommon pulmonary conditions, only 10.85% had received formal training in PCD. Regarding attitudes, 68.2% highlighted the need for institutional support, and 57.8% expressed motivation to expand their understanding of PCD, reflecting variability in confidence levels across the group. The majority of participants (77.7%) regularly employed airway clearance procedures, with PEP devices and chest physiotherapy being the most frequently utilized interventions. In conclusion, while most PTs demonstrated adequate knowledge of PCD and applied best practices in inpatient physiotherapy, continued efforts are needed to strengthen clinical practices and ensure consistent implementation of evidence-based interventions with minimal barriers, particularly within both public and private hospital settings.

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Introduction: Primary ciliary dyskinesia (PCD) is a rare hereditary multisystem disorder characterized by defective motile cilia, which substantially compromises organogenesis, fertility, and mucociliary clearance mechanisms[1, 2]. Fetal ultrasonography may reveal laterality abnormalities in PCD patients, affecting approximately 50% of individuals[3]. Patients demonstrating hypoxemia, respiratory distress, and abnormal chest radiographic findings shortly after birth may necessitate extended hospitalization during the neonatal period[4]. Following the newborn period, patients with PCD typically experience recurrent respiratory tract and ontological infections, chronic nasal congestion, and persistent productive cough manifestations usually evident before six months of age. The majority of patients develop subfertility and progressive bronchiectasis by adulthood[5].

Establishing accurate prevalence estimates for PCD remains challenging, primarily due to insufficient diagnostic methodologies available within many healthcare settings. Although the condition is estimated to affect approximately 1 in 10,000–20,000 infants, underdiagnosis remains prevalent[6, 7]. Furthermore, emerging clinical understanding regarding symptom presentation may enhance awareness of PCD, as clinicians and physiotherapists frequently misdiagnose this condition in children due to limited knowledge and inadequate training opportunities[8, 9].

Regular airway clearance techniques (ACTs) constitute an essential cornerstone of effective PCD management, preventing mucus accumulation and associated respiratory infections. Within this context, physiotherapy assumes a critical role, employing evidence-based techniques including positive expiratory pressure devices, autogenic drainage, and conventional chest physiotherapy[10].

A significant challenge confronting clinical practice is that many physiotherapists implement treatment protocols originally developed for cystic fibrosis (CF) and bronchiectasis when managing PCD patients, largely due to the absence of disease-specific physiotherapy recommendations. Although this pragmatic approach provides a foundational framework, it may inadequately address the distinct pathophysiological characteristics inherent to PCD, potentially compromising patient outcomes. Consequently, systematic evaluation and enhancement of physiotherapists' knowledge, attitudes, and clinical practices regarding PCD management represents a matter of urgent clinical importance[11].

Recent initiatives demonstrate commitment to developing evidence-based physiotherapy practices, exemplified by the establishment of standardized adult PCD physiotherapy treatment protocols in England. These evidence-based standards serve as benchmarks for assessing service quality and ensuring high-quality patient care. However, the extent to which these guidelines will be implemented and adhered to across diverse healthcare settings remains uncertain, necessitating continued investigation of current physiotherapy practices[10].

Contemporary research has documented substantial variability in physiotherapy practices among PCD patients across different healthcare systems. A cross-sectional investigation conducted in Switzerland found that while 80% of individuals with PCD received respiratory physiotherapy, only 30% of adults accessed professional physiotherapy consultations[12]. Such discrepancies suggest potential deficiencies in healthcare professionals' knowledge, attitudes, and clinical practices, particularly among physiotherapists responsible for PCD management.

By offering comprehensive rehabilitation services and delivering structured inpatient physiotherapy, physiotherapists contribute significantly to the functional and respiratory rehabilitation outcomes of patients with PCD. This investigation evaluates the implementation of best practices for PCD management within Pakistani inpatient physiotherapy settings, examining the knowledge, attitudes, and practice barriers among physiotherapists. The ultimate goal of this research is to identify gaps and discrepancies in current management approaches, directing focused educational initiatives and quality improvement efforts to enhance PCD patient outcomes and overall quality of care.

Recruitment of Participants

Physiotherapists currently employed in Lahore, Punjab, Pakistan were recruited for this study. Eligible participants included physiotherapists of both genders holding a minimum qualification of a Bachelor's degree in physiotherapy, with at least one year of clinical experience in government or private hospitals, clinics, or teaching hospitals. Individuals including interns, physiotherapy students, physiotherapy technicians, and non-practicing physiotherapists were excluded from the study. Ethical approval for the study was granted by the Institutional Review Board of the University of South Asia, Lahore, Pakistan (Ref No. IRB-USA-FAHS/2024/14). Prior to participation, all participants were informed about the purpose, scope, and voluntary nature of the study. Written informed consent was obtained from participants engaged in in-person interviews, while online survey participants provided implied consent by voluntarily completing and submitting the questionnaire. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki governing research involving human participants.

Data collection: A self-administered questionnaire was developed following a thorough review of relevant literature and in accordance with internationally recognized physiotherapy practice guidelines, including those of the World Confederation for Physical Therapy (WCPT), the American Physical Therapy Association (APTA), and the Chartered Society of Physiotherapy (CSP)[13– 16] . The questionnaire was designed to evaluate physiotherapists' knowledge of PCD and assess the status of best practice implementation in inpatient physiotherapy settings. To ensure content validity and appropriateness, the instrument was reviewed by a panel of subject matter experts, whose recommended modifications were incorporated into the final version. Prior to full-scale deployment, a pilot study was conducted to assess the clarity, relevance, and content validity of individual questionnaire items. Data were collected through two modalities: an online survey distributed via digital platforms and structured in-person interviews conducted at selected healthcare facilities in Lahore. This dual approach was adopted to maximize participant reach and ensure adequate representation across both public and private healthcare settings.

Questionnaire: The questionnaire comprised five distinct sections designed to comprehensively evaluate physiotherapists' knowledge, attitudes, and clinical practices concerning PCD management in inpatient settings. The first section collected demographic information including participants' age, gender, educational qualification, years of clinical experience, and type of healthcare facility. The second section consisted of six items assessing physiotherapists' knowledge of PCD, encompassing its clinical presentation, diagnostic criteria, and evidence-based management approaches. The third section included six items evaluating physiotherapists' attitudes toward PCD, exploring their confidence, motivation, and perceived importance of specialized training in its management. The fourth section comprised six items examining current clinical practices adopted by physiotherapists when managing PCD patients in inpatient settings. The fifth and final section contained one open-ended question inviting participants to describe the key challenges and barriers encountered when providing inpatient physiotherapy to patients with PCD.

Data analysis: SPSS software version 25 was used to perform statistical analysis. Demographic data was analyzed using Mean ± SD for continuous variable and for categorical variable frequency statistics was used.

Results: A total of 377 physiotherapists were recruited for this study, of whom 306 (81.2%) were male and 71 (18.8%) were female. The mean age of participants was 39.97 ± 10.18 years, with a mean clinical experience of 10.08 ± 5.86 years. Regarding educational qualifications, the majority of participants 238 (63.1%) held a Master of Physiotherapy (MPT) degree, followed by 105 (27.9%) with a Bachelor of Physiotherapy (BPT) and 34 (9.0%) with a doctoral degree (PhD). In terms of specialization, cardiopulmonary physiotherapy was the most prevalent area 149 (39.5%), followed by women's health physiotherapy 58 (15.4%), neurological physiotherapy 51 (13.5%), paediatric physiotherapy 50 (13.3%), sports physiotherapy 35 (9.3%), and musculoskeletal/orthopaedic physiotherapy 34 (9.0%). With respect to institutional affiliation, 147 (39.0%) were employed in private hospitals, 123 (32.6%) in government hospitals, and 107 (28.4%) in teaching hospitals. Of all participants, 140 (37.1%) reported having previously treated a patient with PCD, while 237 (62.9%) had not. Detailed demographic characteristics are presented in Table 1.

Table 1: Demographic Characteristics of Participants (n = 377)

Variable	n (%)
Age (years), Mean ± SD	39.97 ± 10.18
Experience (years), Mean ± SD	10.08 ± 5.86
Gender	
Male	306 (81.2%)
Female	71 (18.8%)
Qualification	
Bachelor of Physiotherapy (BPT)	105 (27.9%)
Master of Physiotherapy (MPT)	238 (63.1%)
Doctor of Philosophy (PhD)	34 (9.0%)
Area of Specialization	
Cardiopulmonary Physiotherapy	149 (39.5%)
Neurological Physiotherapy	51 (13.5%)
Musculoskeletal/Orthopaedic Physiotherapy	34 (9.0%)
Women's Health Physiotherapy	58 (15.4%)
Sports Physiotherapy	35 (9.3%)
Paediatric Physiotherapy	50 (13.3%)
Type of Institution	
Government Hospital	123 (32.6%)
Private Hospital	147 (39.0%)
Teaching Hospital	107 (28.4%)
Previously Treated a PCD Patient	
Yes	140 (37.1%)
No	237 (62.9%)

Knowledge of Physiotherapists Regarding PCD

Six questions were posed to physiotherapists concerning their knowledge of primary ciliary dyskinesia (PCD). The findings revealed that 176 (46.7%) of participants demonstrated accurate knowledge of PCD as a genetic disorder affecting ciliary function in the respiratory tract. Regarding symptom recognition, 225 (59.7%) correctly identified hyperglycemia as a non-typical symptom of PCD, reflecting familiarity with the clinical presentation of the condition. With respect to treatment objectives, 183 (48.5%) correctly identified airway clearance as the primary goal of physiotherapy in PCD management, while 320 (84.9%) recognized chest percussion and postural drainage as the most commonly used airway clearance techniques. Furthermore, 267 (70.8%) correctly identified bronchiectasis as a common consequence of PCD, and 181 (48.0%) acknowledged that PCD diagnosis requires genetic testing and/or ciliary ultrastructure analysis. These findings highlight a moderate level of knowledge among physiotherapists, with particularly strong awareness of airway clearance techniques but notable gaps in understanding of diagnostic criteria and disease pathophysiology. Detailed knowledge responses are presented in Table 2.

Table 2: Knowledge of Physiotherapists Regarding PCD (n = 377)

S.No	Knowledge Question	Response Options	n (%)
1	PCD is a genetic disorder affecting:	Cardiovascular system	59 (15.6%)
		Ciliary function in respiratory tract	176 (46.7%)
		Muscular system	90 (23.9%)
		Gastrointestinal tract	52 (13.8%)
2	Which of the following is NOT a typical symptom of PCD?	Chronic cough	47 (12.5%)
		Nasal congestion	35 (9.3%)
		Clubbing	70 (17.6%)
		Hyperglycemia	225 (59.7%)
3	What is the primary goal of physiotherapy in managing PCD?	Pain relief	132 (35.0%)
		Airway clearance	183 (48.5%)
		Strength training	0 (0.0%)
		Oxygen therapy	62 (16.4%)
4	Which airway clearance technique is most commonly used for PCD patients?	Incentive spirometry	57 (15.1%)
		Chest percussion and postural drainage	320 (84.9%)
		Stretching exercises	0 (0.0%)
		Electrotherapy	0 (0.0%)
5	PCD often results in:	Hypotonia	20 (5.3%)
		Restrictive lung disease	80 (21.2%)
		Bronchiectasis	267 (70.8%)
		Fractures	10 (2.8%)
6	PCD diagnosis requires:	Only clinical signs	47 (12.5%)
		Sputum culture	137 (36.3%)
		Genetic testing and/or ciliary ultrastructure analysis	181 (48.0%)
		Spirometry only	12 (3.2%)

Attitudes of Physiotherapists Toward PCD

To assess attitudes toward PCD management, six questions were administered using a five-point Likert scale. The findings are described across five key attitudinal domains as follows.

Regarding the role of physiotherapists in managing PCD, the majority of participants responded positively, with 190 (50.4%) agreeing and 132 (35.0%) strongly agreeing that physiotherapists play a crucial role in PCD management, while only 9 (2.4%) disagreed and 6 (1.6%) strongly disagreed.

Concerning confidence in providing care, responses were more variable. While 142 (37.7%) agreed and 92 (24.4%) strongly agreed that they felt confident in delivering physiotherapy care to PCD patients, 30 (8.0%) disagreed and 21 (5.6%) strongly disagreed, indicating that a considerable proportion of physiotherapists lack confidence in managing this condition.

With respect to the acknowledgment of inpatient treatment importance, 143 (37.9%) agreed and 76 (20.2%) strongly agreed that treating PCD inpatients is as important as managing other pulmonary conditions. However, 46 (12.2%) disagreed and 33 (8.8%) strongly disagreed, suggesting that awareness of the clinical significance of inpatient PCD management remains inconsistent.

Regarding motivation to improve knowledge, 218 (57.8%) strongly agreed and 96 (25.5%) agreed that it is essential to update their knowledge of rare pulmonary diseases such as PCD. Similarly, 186

(49.3%) strongly agreed and 104 (27.6%) agreed that they were motivated to learn more about airway clearance techniques specific to PCD, collectively reflecting a strong motivation for continued professional development among the majority of participants.

With regard to the need for institutional support, 257 (68.2%) strongly agreed that institutional support is necessary for the effective management of rare diseases such as PCD, with an additional 57 (15.1%) in agreement, underscoring the perceived importance of organizational and systemic enablers in delivering quality PCD care. Detailed attitudinal responses are presented in Table 3.

Table 3: Attitudes of Physiotherapists Toward PCD (n = 377)

S.No	Attitude Question	Response	n (%)
1	I believe physiotherapists play a crucial role in managing patients with PCD.	Strongly Agree	132 (35.0%)
		Agree	190 (50.4%)
		Neutral	40 (10.6%)
		Disagree	9 (2.4%)
		Strongly Disagree	6 (1.6%)
2	I feel confident in providing care to a patient with PCD.	Strongly Agree	92 (24.4%)
		Agree	142 (37.7%)
		Neutral	92 (24.4%)
		Disagree	30 (8.0%)
		Strongly Disagree	21 (5.6%)
3	Treating PCD inpatients is as important as treating other pulmonary conditions.	Strongly Agree	76 (20.2%)
		Agree	143 (37.9%)
		Neutral	79 (21.0%)
		Disagree	46 (12.2%)
		Strongly Disagree	33 (8.8%)
4	It is essential to update my knowledge about rare pulmonary diseases like PCD.	Strongly Agree	218 (57.8%)
		Agree	96 (25.5%)
		Neutral	36 (9.5%)
		Disagree	12 (3.2%)
		Strongly Disagree	15 (4.0%)
5	I am motivated to learn more about airway clearance techniques specific to PCD.	Strongly Agree	186 (49.3%)
		Agree	104 (27.6%)
		Neutral	44 (11.7%)
		Disagree	20 (5.3%)
		Strongly Disagree	23 (6.1%)
6	Institutional support is necessary for effective management of rare diseases like PCD.	Strongly Agree	257 (68.2%)
		Agree	57 (15.1%)
		Neutral	48 (12.7%)
		Disagree	12 (3.2%)
		Strongly Disagree	3 (0.8%)

2.3. Practices of Physiotherapists in Managing PCD

Clinical practice patterns among physiotherapists in the management of PCD patients were examined across six domains. The majority of participants, 293 (77.7%), reported always using airway clearance techniques in pulmonary patients, with an additional 60 (15.9%) reporting frequent use, collectively indicating that over 93% of physiotherapists routinely incorporated airway clearance into their clinical practice. Among the airway clearance techniques employed, the most commonly utilized combination was chest physiotherapy, postural drainage, and oscillatory PEP devices, reported by 127 (33.7%) of participants, followed by chest physiotherapy alone 82 (21.8%), oscillatory PEP devices 50 (13.3%), postural drainage 40 (10.6%), active cycle of breathing techniques 38 (10.1%), and autogenic drainage 20 (5.3%).

Regarding adherence to standardized protocols, 359 (95.2%) of physiotherapists reported following a standard protocol for treating inpatients with rare pulmonary diseases, while only 18 (4.8%) did not. Among those adhering to standard protocols (n = 359), only 39 (10.8%) had attended formal training or continuing medical education (CME) related to PCD or rare lung disorders, representing a notably low proportion compared to the 320 (89.1%) who had received no such training. This disparity highlights a substantial gap between protocol adherence and formal professional education in PCD management. Furthermore, 263 (73.3%) reported regularly documenting treatment outcomes for PCD or similar pulmonary conditions, while 204 (56.8%) expressed willingness to undergo additional training or certification in PCD management, suggesting a receptive attitude toward professional development despite limited prior training opportunities. Detailed practice responses are presented in Table 4.

Table 4: Clinical Practices of Physiotherapists in Managing PCD (n = 377)

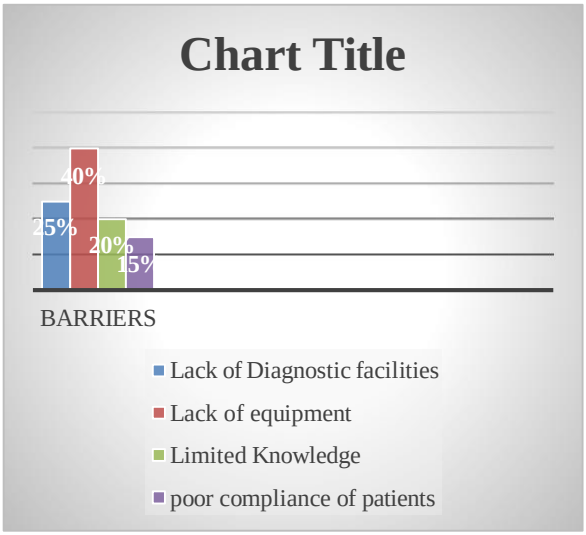
S.No	Practice Question	Response	n (%)
1	How often do you use airway clearance techniques in pulmonary patients?	Always	293 (77.7%)
		Often	60 (15.9%)
		Sometimes	12 (3.2%)
		Rarely	12 (3.2%)
		Never	0 (0.0%)
2	Which airway clearance techniques do you commonly use?	Chest physiotherapy (manual)	82 (21.8%)
		Postural drainage	40 (10.6%)
		Oscillatory PEP devices	50 (13.3%)
		Active cycle of breathing techniques	38 (10.1%)
		Autogenic drainage	20 (5.3%)
		All mentioned techniques	20 (5.3%)
		Chest physiotherapy, postural drainage and oscillatory PEP devices	127 (33.7%)
3	Do you follow any standard protocol for treating inpatients with rare pulmonary diseases?	Yes	359 (95.2%)
		No	18 (4.8%)
4	Have you ever attended any training or CME related to PCD or rare lung disorders? (n = 359)	Yes	39 (10.8%)
		No	320 (89.1%)
5	Do you regularly document treatment outcomes for PCD or similar pulmonary patients? (n = 359)	Yes	263 (73.3%)
		No	96 (26.7%)
6	Would you be willing to undergo additional training or certification in managing PCD? (n = 359)	Yes	204 (56.8%)
		No	155 (43.2%)

Barriers to PCD Management

Physiotherapists participating in this study identified several key barriers to effective inpatient PCD management. The most frequently reported challenges included late diagnosis, limited access to specialized diagnostic equipment, insufficient knowledge of PCD management, lack of continuing professional development (CPD) programs, and poor patient compliance. Late diagnosis was primarily attributed to the limited availability of diagnostic facilities for PCD in Lahore, Pakistan, where the majority of patients are misdiagnosed with asthma or chronic bronchitis, resulting in delayed initiation of appropriate management and increased frequency of respiratory infections. Poor patient and caregiver awareness regarding the importance of chest physiotherapy was also identified as a significant barrier, contributing to suboptimal treatment compliance and subsequent disease exacerbation. Additionally, the high patient load in tertiary care hospitals across Pakistan was noted as a systemic constraint that limits the availability of individualized physiotherapy sessions, further compromising the quality of PCD care delivered in inpatient settings. A summary of reported barriers is illustrated in Figure 1.

Figure 1

Barriers PTs faced in treating PCD patients



Discussion

This cross-sectional study investigated the knowledge, attitudes, and clinical practices of physiotherapists regarding primary ciliary dyskinesia (PCD) management in inpatient settings across Lahore, Pakistan. The findings reveal a complex picture characterized by moderate foundational knowledge, generally favorable professional attitudes, and

reasonably consistent clinical practice, yet undermined by significant gaps in formal training, diagnostic understanding, and institutional support. The following discussion explicitly contextualizes each finding against previously published evidence, drawing clear distinctions between what the present study observed and what has been reported in the existing international literature.

Knowledge of Physiotherapists Regarding PCD

The present study found that only 46.7% of physiotherapists correctly identified PCD as a disorder affecting ciliary function in the respiratory tract. This figure is notably lower than knowledge levels reported in comparable studies conducted in higher-resource settings. For instance, studies evaluating healthcare professionals' knowledge of rare respiratory conditions in European clinical environments have consistently reported substantially higher rates of pathophysiological awareness, attributed primarily to the availability of structured postgraduate training programs and greater clinical exposure to rare pulmonary diseases[17 – 19] . In contrast, the present study's findings reflect the educational and infrastructural constraints characteristic of the Pakistani healthcare context, where PCD receives limited emphasis in both undergraduate physiotherapy curricula and continuing professional development programs. This distinction is critical, as it suggests that the knowledge deficit observed in the present study is not primarily attributable to individual professional disengagement but rather to systemic educational gaps that require targeted institutional intervention.

Regarding symptom recognition, the present study found that only 59.7% of physiotherapists accurately identified the correct symptom constellation associated with PCD, including chronic cough, nasal congestion, and clubbing, while 38% demonstrated inadequate symptom knowledge. This finding contrasts markedly with established clinical literature, which confirms that in childhood, nearly all patients with PCD experience nasal congestion and persistent productive cough, with recurrent lower respiratory tract infections documented as near-universal manifestations of the condition[5] . Furthermore, bilateral otitis media with effusion and persistent rhinitis have been documented in the majority of children with PCD in well-characterized clinical cohorts[20 , 21], and clinical investigations have consistently demonstrated that virtually all infants with PCD experience coughing, with clubbing evident in significant patient subsets[22]. The gap between what the present study found and what the clinical literature establishes as expected symptom knowledge suggests that physiotherapists in Pakistan are encountering PCD patients without the foundational clinical knowledge necessary for early recognition, a disparity not prominently highlighted in studies conducted in settings with established PCD diagnostic pathways.

Concerning physiotherapy management knowledge, the present study identified an important internal discrepancy: while 84.9% of participants recognized chest percussion and postural drainage as the most commonly employed airway clearance techniques, only 48.5% correctly identified airway clearance as the primary goal of physiotherapy management in PCD. This divergence between technique familiarity and conceptual understanding has not been previously documented in the PCD-specific literature and represents a novel finding of the present study. Prior studies have consistently established that airway clearance is the central objective of physiotherapy in PCD, with conventional chest physiotherapy, postural drainage, vibration, and percussion collectively recognized as the standard treatment framework[23– 25] . The present study's finding that technique awareness substantially exceeds goal comprehension suggests a pattern of practice-without-understanding that may limit physiotherapists' capacity to adapt interventions appropriately to individual patient presentations, a concern not previously raised in comparable investigations.

Regarding diagnostic knowledge, the present study revealed that only 48.0% of physiotherapists correctly identified genetic testing and ciliary ultrastructure analysis as the definitive diagnostic criteria for PCD, while 36.3% incorrectly identified sputum culture and 12.5% cited clinical signs alone as sufficient for diagnosis. These findings stand in stark contrast to the well-established diagnostic literature, which confirms that PCD diagnosis requires a combination of clinical characteristics, genetic testing, and specialized diagnostic procedures including transmission electron microscopy and nasal nitric oxide measurement, many of which require costly equipment and specialized expertise[26] . Studies conducted in European and North American settings report considerably higher rates of diagnostic knowledge among allied health professionals, largely attributable to exposure to multidisciplinary PCD diagnostic teams and formalized rare disease training pathways. The present study's findings suggest that physiotherapists in Pakistan are operating in a diagnostic knowledge vacuum that substantially differs from the international standard, potentially compromising their capacity to recognize undiagnosed PCD cases presenting to physiotherapy services.

Attitudes of Physiotherapists Toward PCD

The present study found that 85.4% of physiotherapists acknowledged the crucial professional role of physiotherapists in PCD management, and 83.3% expressed willingness to

update their knowledge and skills regarding PCD. These attitudinal findings compare favorably with data reported from studies conducted in other low- and middle-income countries (LMICs), where healthcare professionals' motivation to engage with rare disease management has similarly been found to be high despite limited formal preparation[11]. However, a critical distinction emerges when comparing attitudinal findings with actual practice preparedness: while motivation and role awareness were high in the present study, only 62.1% expressed confidence in their clinical competence to manage PCD patients, and fewer than 60% considered inpatient PCD management as clinically important as other pulmonary conditions. This attitudinal inconsistency between role awareness and clinical confidence has not been explicitly quantified in prior PCD-specific studies, making it a distinctive contribution of the present investigation.

In contrast, studies conducted in England, where standardized adult PCD physiotherapy treatment protocols have been formally established, report considerably higher levels of professional confidence and role clarity among physiotherapists managing PCD[10] . This comparison directly implicates the absence of equivalent national clinical guidelines in Pakistan as a primary driver of the confidence deficit observed in the present study, rather than a lack of professional motivation. This distinction is analytically important: it shifts the focus of intervention from individual professional development to systemic guideline development and institutional policy reform.

The finding that 68.2% of participants strongly agreed on the necessity of institutional support for effective PCD management represents the highest agreement level across all attitudinal domains in the present study. This finding is consistent with broader literature on rare disease management in resource-limited settings, which consistently identifies institutional commitment as the single most influential determinant of healthcare quality for conditions with limited epidemiological visibility[11]. However, the present study extends this finding by demonstrating that even within a setting where institutional support is widely perceived as necessary, its actual provision remains severely limited, creating a significant gap between perceived need and realized support that has not been comparably documented in the Pakistani physiotherapy literature.

Clinical Practices of Physiotherapists in PCD Management

The present study found that 77.7% of physiotherapists consistently employed airway clearance techniques in pulmonary patients, with the combination of chest physiotherapy, postural drainage, and oscillatory PEP devices representing the most frequently utilized approach, reported by 33.7% of participants. When compared with international practice data, these figures present a mixed picture. A cross-sectional investigation conducted in Switzerland reported that 80% of individuals with PCD received respiratory physiotherapy[12]. a figure broadly comparable to the present study's findings. However, a critical contextual distinction must be drawn: the Swiss study documented practices within a well-resourced healthcare system with established PCD diagnostic and management pathways, whereas the present study's participants were operating largely without formal PCD-specific training or institutional guidelines. The similar practice rates therefore reflect fundamentally different clinical contexts, suggesting that Pakistani physiotherapists are achieving comparable surface-level practice metrics through protocol adherence rather than evidence-based competence, a distinction not previously articulated in the comparative literature.

The European Respiratory Society's PCD task force guidelines emphasize the value of regular airway clearance procedures, appropriate use of antibiotics, and avoidance of harmful environmental exposures as core components of PCD management[27] . The present study's findings indicate that physiotherapists in Lahore are broadly aligned with the airway clearance component of these recommendations, yet the absence of awareness regarding the broader management framework, including infection prevention strategies and environmental risk avoidance, suggests partial rather than comprehensive guideline adherence. Prior studies have not specifically examined this partial alignment phenomenon within LMIC physiotherapy settings, making this a novel observation of the present investigation.

The most critically distinctive finding of the present study in the practice domain is the profound discrepancy between clinical protocol adherence (95.2%) and formal training acquisition (10.85%). No comparable study in the existing PCD physiotherapy literature has documented a training gap of this magnitude. Studies conducted in European settings consistently report that protocol adherence is closely correlated with formal training and continuing professional development participation, suggesting that in well-resourced environments, practice quality and training attainment develop in parallel[10, 23]. The present study's findings directly challenge this assumption by demonstrating that high protocol adherence can coexist with near-complete absence of formal training, raising fundamental questions about the nature and quality of evidence-based practice in resource-limited settings. This finding represents one of the most significant and novel contributions of the

present study to the international literature on PCD physiotherapy management.

Barriers to PCD Management

The present study identified delayed diagnosis, limited diagnostic infrastructure, insufficient CPD provision, poor patient compliance, and high institutional patient loads as the primary barriers to effective PCD management among physiotherapists in Lahore. While delayed diagnosis and diagnostic infrastructure limitations have been consistently documented as barriers in the international PCD literature[28] , the present study extends this evidence base by situating these barriers within the specific context of the Pakistani healthcare system, where PCD is routinely misdiagnosed as asthma or chronic bronchitis due to the near-complete absence of genetic testing and ciliary ultrastructure analysis facilities. This contextual specificity differentiates the present findings from European and North American barrier studies, which typically focus on optimizing existing diagnostic pathways rather than addressing their fundamental absence.

The barrier of poor patient compliance reported in the present study, attributed primarily to inadequate patient and caregiver awareness of the importance of chest physiotherapy, reflects a pattern documented in comparable LMICs but contrasts markedly with findings from high-resource settings, where patient education programs and self-management support infrastructure are well established components of PCD care pathways[29] . The BESTCILIA consortium, a collaborative initiative sponsored by the European Commission, has demonstrated that coordinated, multi-stakeholder approaches to PCD barrier reduction, integrating diagnostic development, clinical guideline dissemination, and patient advocacy, can yield measurable improvements in care quality across diverse healthcare contexts[29] . The present study's findings suggest that adapting the BESTCILIA model to the Pakistani healthcare context, with specific emphasis on diagnostic infrastructure investment and community-level patient education, represents a viable and evidence-informed pathway toward systematically addressing the barriers identified.

The barrier of high institutional patient loads, while broadly consistent with challenges documented across tertiary care settings in Pakistan and other LMICs, has not been previously examined specifically in relation to PCD physiotherapy practice quality. The present study's identification of this barrier in the context of a rare disease requiring individualized, technique-intensive physiotherapy intervention represents a novel contribution that highlights the need for rare disease-specific staffing and resource allocation policies within Pakistani public hospitals.

Limitations:

The present study has several limitations that should be considered when interpreting its findings. As the study was conducted exclusively in Lahore, Punjab, the generalizability of findings to other provinces and regions of Pakistan remains limited, given that healthcare infrastructure, training opportunities, and clinical exposure to PCD may vary considerably across different settings. The cross-sectional design further precludes the establishment of causal relationships between knowledge, attitudes, practices, and patient outcomes, and reliance on a self-administered questionnaire introduces the possibility of social desirability bias, whereby participants may have overreported favorable knowledge or clinical practices.

Conclusion:

To the authors' knowledge, this is the first study to examine the knowledge, attitudes, and clinical practices of physiotherapists regarding PCD management in inpatient settings in Pakistan. The findings demonstrate that while physiotherapists in Lahore possess moderate foundational knowledge of PCD and consistently employ airway clearance techniques in clinical practice, this engagement is largely driven by habitual protocol adherence rather than formal evidence-based training, as reflected by the stark disparity between the 95.2% adhering to standard protocols and the 10.85% who had received formal PCD-specific training. International evidence consistently demonstrates that structured, competency-based physiotherapy training is directly associated with improved airway clearance outcomes, reduced exacerbation frequency, and enhanced quality of life in PCD patients[23– 25] , underscoring the urgent need to bridge this training gap within the Pakistani healthcare context. To achieve this, the integration of rare pulmonary disease management into physiotherapy curricula, the development of PCD-specific continuing professional development programs aligned with European Respiratory Society task force guidelines[27] , and sustained investment in diagnostic infrastructure and multidisciplinary team-based care are strongly recommended. Ultimately, Pakistani physiotherapists represent a motivated clinical workforce well positioned to deliver high-quality PCD care, provided that the institutional, educational, and systemic enablers necessary to support evidence-based practice are established and consistently maintained.

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Conflict of Interest:
None reported.

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