



# Current status and barriers in pulmonary hypertension care delivery in India: A qualitative analysis

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## Abstract

Although pulmonary hypertension (PH) is widely prevalent in India, care delivery for this condition has unique challenges in a lower middle-income country (LMIC). To describe care delivery for patients with PH and associated barriers in India. We interviewed physicians across eight healthcare systems in India about PH clinical care using semi-structured enquiries to understand care delivery and associated challenges in their specific practice as well as the associated health system. Qualitative analysis was performed using content analysis methodology. Physicians reported that common causes for PH in their practice were rheumatic mitral valve disease, coronary artery disease, and congenital heart disease (CHD). No center had a dedicated PH program. Only one center had a specific protocol for PH management. Diagnostic evaluations were limited, and right heart catheterizations were recommended for patients

**Abbreviations:** CHD, congenital heart disease; CT, computed tomography; CTEPH, chronic thromboembolic pulmonary hypertension; LMICs, lower middle-income countries; PH, pulmonary hypertension; PTE, pulmonary thrombo-endarterectomy; RHC, right heart catheterization; RHD, rheumatic heart disease; V/Q scan, ventilation perfusion scan; WHO, World Health Organization.

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with CHD. Pulmonary vasodilator therapy was used for severe symptoms or markers of severe disease. Agents used to treat PH were widely variable across physicians and prostacyclins are unavailable in India. Barriers included limited training in PH for physicians, lack of consensus guidelines for PH specific to LMIC, and lack of financial incentives for health care systems to organize dedicated PH programs. Other barriers included poor patient health literacy and socioeconomic barriers that limit ability to test and treat PH. PH care delivery in India is variable with widely differing clinical practices. Dedicated training in PH management and establishing guidelines specific to LMIC like India can form the first step forward.

#### KEYWORDS

economics, epidemiology, middle- and low-income countries, social factors

## INTRODUCTION

Pulmonary hypertension (PH) is a heterogeneous disease characterized hemodynamically by elevated pulmonary artery pressures (mean PA pressure >20 mmHg). A clinical classification distinguishes five categories based on the underlying pathophysiologic mechanism and therapeutic management.<sup>1</sup> Pulmonary arterial hypertension, or Group 1 PH, is a rare and morbid condition that may lead to early death if not treated aggressively.<sup>2</sup> Other forms of PH, such as PH due to left heart disease (Group 2 PH) and PH due to parenchymal lung disease and/or hypoxia (Group 3 PH), are more prevalent and complicate a subset of patient who have significant left heart disease and lung disease. Chronic thromboembolic pulmonary hypertension (CTEPH) or Group 4 PH, is also an uncommon condition that can complicate up to 4% of acute pulmonary embolisms. Group 5 PH encompasses miscellaneous and/or multifactorial mechanism of PH. PH is widely prevalent in India due to the ubiquitous nature of predisposing conditions such as rheumatic heart disease, chronic thromboembolic pulmonary vascular disease, and untreated congenital heart disease (CHD).<sup>3</sup> While the majority of the global PH burden is seen in LMIC like India, access to guideline-recommended PH management is limited.<sup>4</sup> Optimizing PH care in LMIC like India requires an understanding of current PH practice and unique challenges encountered during PH care delivery.

Accordingly, the purpose of our study was to systematically assess models of PH care in the Indian medical system and identify common barriers encountered. More specifically, using semi-structured qualitative enquiries that we deployed at 8 large, tertiary care centers in India, we first describe how PH is

diagnosed and treated. Next, we sequentially assessed challenges encountered by physicians in providing high-quality care.

## METHODS

### Study design and site selection

This was a qualitative study aimed at examining delivery of PH care in India and identifying associated challenges. We used purposive and snowball sampling to contact clinical physician leads at eight institutions initially by email to explain goals and procedures of this study and to request participation. Purposive sampling is a type of sampling where individuals meeting certain criteria are directly approached by the investigators and with snowball sampling a participant is asked to refer to other appropriate participants.<sup>5</sup> Institutions were selected based on location, level of care and type of hospital (academic and nonacademic) to get a widely representative sample.

### Interview process and data collection

We conducted semi-structured interviews using cloud-based video conferencing software, Zoom.<sup>6</sup> The interviews consisted of open-ended questions with specific probes asking about diagnostic evaluation and treatment approaches used in management of PH patients and identifying associated challenges. We specifically targeted the following three broad domains: (1) delivery of PH care at the center, (2) diagnostic workup performed for PH patients, and (3) PH therapies provided. To assess

delivery of PH care, we enquired about specific clinics dedicated to PH patients, training and expertise for physicians, and available infrastructure. For diagnostic workup, we assessed diagnostic modalities used to diagnose, classify and grade PH and specifically enquired about assessing exercise capacity, using right heart catheterization (RHC), vasoreactivity testing, echocardiographic assessment of right ventricular function, and other laboratory variables.

To understand use of therapies, we first assessed real-world indications for PH therapy. We also explored whether physicians follow any specific guidelines regarding agents prescribed and follow-up care. Additionally, we asked about barriers in prescribing medical therapies for PH. Finally, we enquired about use of minimally invasive and surgical treatments for PH such as atrial septostomy, balloon pulmonary angioplasty, pulmonary thromboendarterectomy (PTE), and lung transplantation.

The interview guide was created by obtaining input from a multidisciplinary research team composed of general cardiologists, PH specialists, heart failure specialists, and interventional cardiologists. The guide was pretested with two interviews at the local study site (University of Michigan Frankel Cardiovascular Center) to obtain input and further refine it.

Each interview was performed by two investigators (A. R. M. and V. A.) trained in qualitative methods to ensure consistency. Informed consent was obtained from all participating individuals before the interviews and then recorded. We specifically did not request any identifying information relating to the center or physician to obtain candid feedback. All interviews were transcribed and subsequently analyzed. Interviews were performed until thematic saturation was attained. The Frankel Cardiovascular Center, University of Michigan, Ann Arbor, was the coordinating center.

## Qualitative analysis

We used an iterative, inductive, and deductive toolkit of analytical strategies drawing predominantly on content analysis methodology.<sup>7</sup> Each interview was first coded by in-depth reading of the interviews followed by initial inductive coding. Additional codes were then identified with addition of deductive codes based on interview questions and a prior knowledge of the process. Each interview was coded by two separate investigators (A. R. M. and V. A.) and all disagreements were sorted out by a third investigator (S. S.).

After initial coding was completed, all analysts (A. R. M., V. A., and S. S.) compared and combined codes to clarify code interpretation and an initial codebook was formulated. Emergent codes were added throughout the

process and the new emerging codes were then added to the remaining interviews. This allowed us to expand our findings. An intercoder agreement based on coding passages the same way with codes was assessed with an agreement of over 80%. Preliminary results were reviewed with the multidisciplinary research team to assess thoroughness and representativeness. The analytic team met weekly to discuss codes, themes, and emerging conclusions. An audit trail was maintained to document all procedures and decisions.

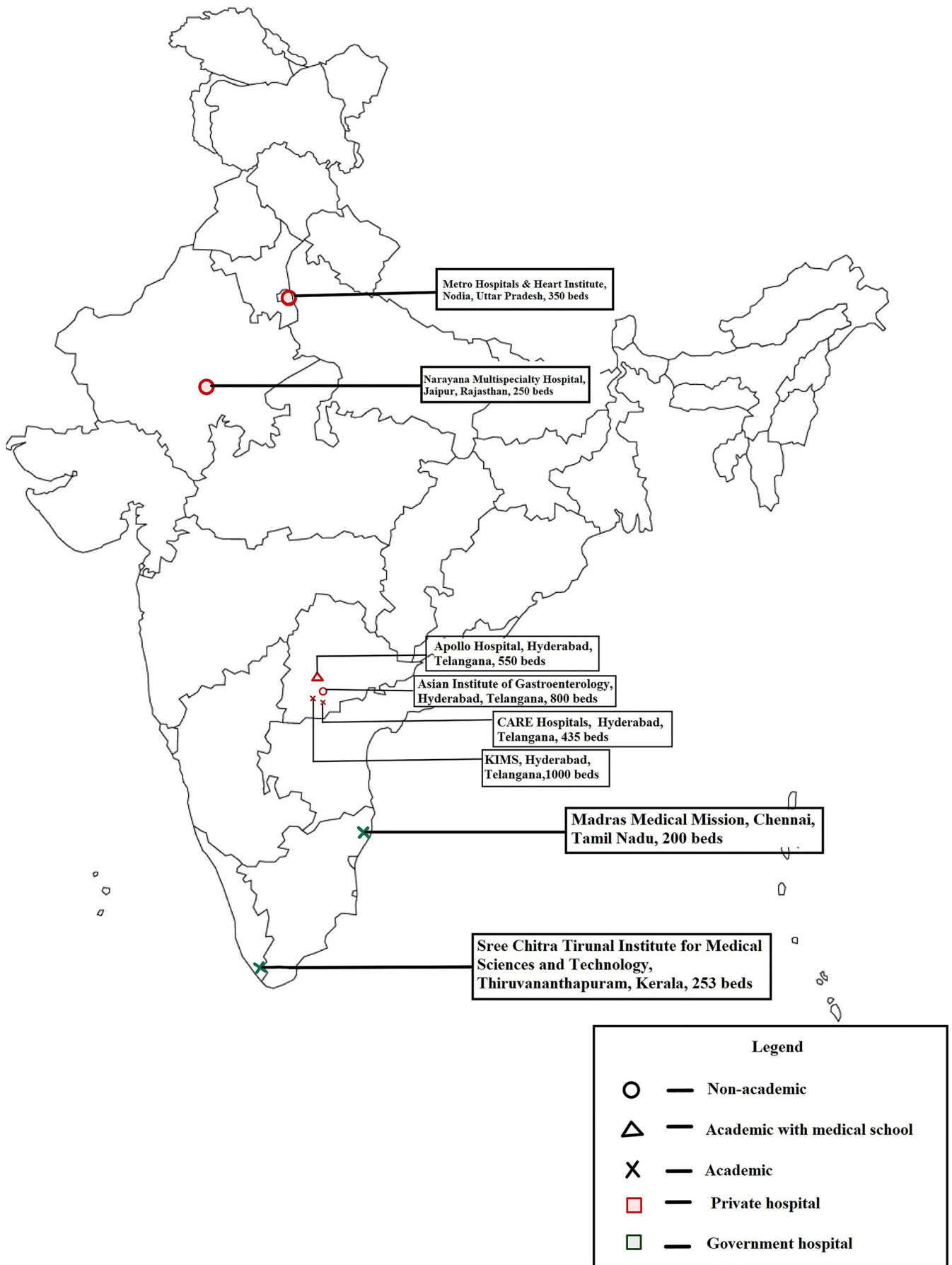
We performed investigator triangulation where the same data were interpreted by multiple investigators of different backgrounds. Triangulation is a method of establishing validity of qualitative methods by analyzing the research question from multiple viewpoints.<sup>8</sup> In our study, the interinvestigator agreement during analyses exceeded 80%.

## RESULTS

We conducted interviews with physician leads at eight centers located in five metro cities in India (Figure 1). Overall, median age was 52 years, and 7 physicians were male. These physicians had a median of 19 years of clinical experience. All interviewed physicians completed medical school in India. Three physicians currently practicing in India did fellowship training in the United States and were formally trained in PH management. Two other physicians had taken the initiative to obtain exposure at a PH center of excellence in the United States and in the United Kingdom. One center was associated with a medical school, four were not affiliated with medical schools but had fellowships in cardiovascular medicine and three were private, non-academic institutions. For four centers, majority of the patients paid out of pocket or were privately insured, at two centers patients insured through government schemes formed the vast majority and the remaining two centers reported a mix of patients paying out of pocket or with private and government-sponsored insurances. All physicians reported predominantly caring for patients with WHO Class 2 or Class 3 PH. Most felt PH in India was predominantly due to rising burden of coronary artery disease, wide prevalence of rheumatic mitral valve disease, and delayed identification of CHD. Table 1 lists all key themes identified as barriers in provision of high-quality PH care in India.

### Delivery of PH care

All physicians reported a lack of dedicated PH teams at their center. At one center, pulmonologists were more likely to see PH patients and other seven centers reported



**FIGURE 1** Geographic map of India highlighting location and characteristics of centers studied.

**TABLE 1** Key themes identified as barriers encountered in management of patients with PH in India.

<b>Barriers encountered in managing patients with PH in India</b>	
<i>Care delivery</i>	
Lack of multidisciplinary PH teams and protocols	“There are few physicians with PH training. There is no systematic follow-up for patients leading to poor outcomes. There are no dedicated physicians. Everyone is seeing everyone. These are specialized fields and there is a need to develop a niche.”
Lack of infrastructure for PH programs	“Each physician sees 60–70 patients in 1 day. We can’t spend time with all these patients and small details are missed. We are still better than smaller hospitals because we at least have some infrastructure. Government hospitals don’t have any funds.”
Lack of training for physicians in PH	“Training in India focuses on coronary artery and valvular heart disease. The right ventricular systolic pressure is assessed on echo. Physicians always treat the primary issue and pulmonary hypertension is not a concern—it is an adjunct diagnosis, and this includes pulmonary embolism. It is not thought of as an isolated disease needing treatment.”
No financial incentive for establishing PH programs	“PH clinics do not provide financial incentives to hospitals. These new PH drugs have a high cost and limited availability. We are too occupied with coronary artery disease.”
<i>Diagnostic workup</i>	
Financial barriers for testing	“Insurances do not cover testing—most packages are about CAD/valvular heart disease. There is nothing specific for PH. We are paid a nominal sum for procedures and there is no coverage for equipment needed.”
Lack of testing capabilities	“Very few centers have ventilation-perfusion scans—it is not available at my center. So, a patient needs to be referred out for it and we don’t want to create a practice that “sends patients to a different hospital.”
Poor patient health literacy	“Right heart cath is not very frequently done in the community and hence patients are reluctant because the terminology includes the word ‘angio’. So, they consult with other doctors who do not get it done. Patients present to us in very late stage then because the local doctor treats them with a diuretic and calcium channel blocker, and they keep getting worse.”
Perception that recommended tests are not routinely useful	“How will the right heart cath help—I know the PA Pressures are high. We don’t have inhaled Nitric Oxide or Prostaglandins available so vasoreactivity testing is difficult to perform. They may have it at tier 1 centers. We give 100% oxygen in place which is not the gold standard and repeat the right heart catheterization. So, it is always a matter of debate if it gives the correct result or not. Patients anyway would be on therapy before the cath so how to interpret the right heart catheter results is challenging.”
<i>Treatment for PH</i>	
Differences in population being treated compared to Western world	“There are no prostacyclins available—they are expensive. It was expensive in the 1990s and is likely more expensive now. There is a lack of resources like electricity and cleanliness. They are difficult to administer and understand. In a clinical trial with epoprostenol, they noted a high fatality rate in India because of sepsis.”
Lack of resources for procedures such as balloon pulmonary angioplasty or pulmonary thrombo-endarterectomy	“There is a lack of training, cost and lack of resources (such as balloons and wire) for these procedures. We need new hardware for each procedure which will increase cost. The hospital will say: why are you doing a procedure needing so much hardware.”

predominantly cardiologists caring for PH patients. However, all physicians noted that “*Everyone sees everyone*” and lack of specialization in PH. All physicians universally voiced lack of available infrastructure for specialized PH teams and clinics and raised issues

ranging from lack of clinic space, lack of time due to high patient volume with other cardiovascular conditions such as coronary artery disease in their clinics, and lack of partners in other subspecialties such as physical medicine and rehabilitation and pulmonology needed for



a multi-disciplinary PH program. Only one center reported using a common protocol for workup and management of PH patients. All other centers reported lack of centralized consensus protocol-driven care for PH patients leading to fragmentation and perceived sub-optimal patient care. As one physician noted *“I am doing the best I can without a common protocol.”*

Several physicians also noted that PH clinics financially do not benefit hospital systems leading to a lack of interest in creating multi-disciplinary PH teams. One physician reported that unlike care for coronary artery disease where patients are offered bundled payment options by hospital systems and insurance companies; for PH such bundled payment options do not exist and oftentimes physicians are paid a nominal sum. All physicians reported equipment cost as a barrier in using procedures such as RHC for PH diagnosis and further risk stratification.

Majority of physicians also reported a lack of training in PH and its management during medical education in India. These physicians felt that medical training in India heavily focuses on treatment of coronary artery disease and valvular heart disease leading to poor awareness among community physicians on PH prevalence and management. One physician stated *“PH care revolves around treating the primary cause and not PH itself. PH is considered an adjunct diagnosis.”*

## PH diagnostic workup

All physicians reported initiating workup for PH with a detailed clinical history and exam, echocardiogram, and chest X-ray. With the exception of two physicians, others did not routinely recommend a RHC for all PH patients—however, these two physicians noted that they formed a small minority in this practice at their center. Other physicians reported obtaining RHC only for patients with significant symptom burden despite medical therapy, when PH is associated with CHD for a shunt assessment or for those with echocardiographic findings of medically refractory severe PH as marked by severe right-sided chamber dilatation or enlarged pulmonary arteries. All physicians reported difficulty with vasoreactivity testing due to unavailability of inhaled nitric oxide—some reported using adenosine and others reported using inhaled oxygen or sublingual nitroglycerin.

There were several other barriers reported with obtaining RHC. These included associated costs as patients pay out of pocket and medical insurance oftentimes does not cover outpatient diagnostic testing. These cost issues lead to logistical difficulties such as patients needing an inpatient stay to finish elective

diagnostic testing. In addition, two physicians noted there was significant expense related to catheters needed for RHC and/or the prolonged cardiac catheterization laboratory time need for RHC (vis-a-vis coronary angiogram) which reduced the hospital's profit margins. Other concerns regarding an RHC included uncertainty regarding usefulness in the absence of vasoreactivity testing, uncertainty about what an RHC would add to information obtained on echocardiogram and possible associated risks with the procedure in sick patients. One physician noted *“How will the cath study help—I know the PA pressures are high.”* Finally, all physicians noted that patients are always reluctant to have invasive procedures. They risk losing the patient to another physician if they recommend an invasive procedure such as RHC, as they may get a different opinion about utility and need for RHC from a different physician. There is wide variability in physician practice which adds to the confusion for a patient.

Other testing obtained *in case of clinical suspicion* for the condition included testing for connective tissue disorders, CT chest with contrast for pulmonary embolism, pulmonary function tests and sleep testing. One physician noted *“We can't do tests for everyone but tailor tests to patients.”* Only three centers reported having access to ventilation-perfusion (V/Q) scans at their center. Most physicians reported relying on CT chest angiogram for chronic thromboembolic pulmonary vascular disease diagnosis given limited availability and limited expertise with interpreting V/Q scans. Some physicians also reported perceived lack of utility in obtaining a V/Q scan over a CT chest angiogram as they believed a CT chest angiogram would rule out large proximal thrombus burden, provide the ability to visualize lung parenchyma and since CTEPH is a rare cause of PH. All physicians felt the need to restrict testing to a basic minimum to avoid adding financial burden for the patient. One physician noted that *“CTEPH is widely underdiagnosed, and some physicians use a D-dimer and peripheral venous dopplers to rule it out.”*

While most centers could obtain 6-min walk tests, all physicians reported that serial assessments were not made to minimize patient's cost burden. Cardio-pulmonary stress testing was available at only two centers.

## Medical therapy for PH in India

We noted significant variation in medications used for treatment of PH. All physicians reported that their current practice is heavily driven by anecdotal experience and cost considerations. Some also voiced concerns about

published guidelines from the developed world being inapplicable to a LMIC like India where cost and logistics are major barriers and PH etiologies differ.

Some physicians reported not initiating any treatment for patients with mild to moderate PH and reserving treatment for either patients with substantial symptoms or markers of severe PH based on echocardiograms. Two physicians reported using calcium channel blockers as the first agent of choice. Another physician reported using calcium channel blockers for patients with positive vasoreactivity test on RHC. Two other physicians reported initiating sildenafil as the first agent of choice as it is inexpensive. Two other physicians reported using upfront combination therapy with an endothelin receptor antagonist in patients who could afford these medications and the others reserved combination therapy as a second line for patients who failed sildenafil or calcium channel blockers. Agents of choice for combination therapy were usually ambrisentan and tadalafil due to their once daily dosing. Several physicians noted availability of riociguat but reported high price of the medication leading them to use it in patients failing combination therapy or with inoperable CTEPH. Some physicians also reported using digoxin for patients with right ventricular failure. Medication choices were generally similar regardless of underlying WHO PH category.

While all physicians noted that oral agents were readily available, inhalational, and infusion therapies (prostacyclins) are not available. A few physicians raised concerns about using continuous infusion therapies for PH due to poor socioeconomic conditions and associated infection risk as noted in the TRUST-1 clinical trial testing feasibility of remodulin infusion in India.<sup>9</sup> Some noted challenges with warfarin as well noting difficulty in maintaining time in therapeutic range particularly among patients who travel long distances to obtain healthcare in metro areas from small villages.

Only four centers had a pulmonary rehabilitation program. Physicians at these centers noted that participation was limited by lack of insurance coverage for it and due to geographic restrictions as patients have to travel substantial distances from their hometown. At the four centers that lacked pulmonary rehabilitation, the primary reason was lack of funding for the needed infrastructure.

## Surgical and interventional therapies for PH

Surgical and interventional therapies for PH are used predominantly for CHD or for other causes of Group 2 PH such as rheumatic mitral valve disease and coronary artery disease. Some physicians reported initiating a

pulmonary vasodilator upfront in patients with PH due to CHD and establishing improvement in pulmonary vascular resistance before referring patients for surgery. All physicians noted that PH associated with CHD is diagnosed late in adulthood and is commonly accompanied by Eisenmenger syndrome. Limited resources for adequate screening and workup for CHD in early childhood were the most common barrier.

For CTEPH, three centers we interviewed offered PTE. Universally faced challenges in having a PTE program included lack of surgical expertise and lack of critical care support for peri-operative management of these patients. PTE being a resource-intensive procedure associated with high morbidity and mortality is believed to be financially less rewarding among surgeons when compared to other routine surgical procedures in India. Nonetheless, even at centers with PTE programs, physicians reported that only 30%–40% eligible CTEPH patients undergo the surgery. From the physicians' perspective, reasons behind these included cost for patients and poor health literacy where patients did not understand the need for it. One physician noted *"If you recommend a surgery, first patients start bargaining about the cost and then worry about risks and benefits."*

Balloon pulmonary angioplasty is not offered at any of the centers we interviewed. Barriers reported were very similar to PTE and included lack of physician expertise, fear of complications and poor cost reimbursement of the needed equipment.

Physicians also reported that lung transplantation was rarely offered for PH in India. Some physicians voiced concerns regarding lung transplant being a viable option in a LMIC like India where post-transplant management would be challenging due to high infection risk, associated costs with need for multiple post-transplant tests such as biopsies and lab draws for drug level monitoring. In addition, surgical and medical expertise around transplantation is limited to very few centers. Other challenges highlighted included limited donor organ availability and social stigma about organ donation and acceptance in Indian culture at large.

Finally, in India, palliative care is underutilized as most patients perceive that they are in late stages of disease and feel that palliative procedures like atrial septostomy are invasive and expensive. We also observed that physicians are reluctant towards offering palliative procedures as these procedures are unrewarding, cumbersome, and invasive.

## DISCUSSION

Our goal was to study care provided to patients with PH in India by interviewing physicians across major health care systems. First, we observed a universal lack of

multidisciplinary dedicated PH teams. Second, we found variation in physician management strategies ranging from use of basic diagnostics such as RHC to medical therapies used. Third, we found that universal barriers in provision of high-quality care for PH included lack of infrastructure and training with a general perception in the medical community that PH is a secondary disease. Furthermore, physicians struggle with providing high-quality care due to cost barriers, limited health literacy, and socioeconomic issues. These barriers were common for both physicians working at a privately funded medical center and in resource-restricted publicly funded hospitals, although they were more pronounced in the latter. Table 2 lists all common perceived thematic barriers in PH care delivery in India.

While the true prevalence of PH in India is not known, it is notable that in a single year and in one state in India, PROKERALA registry was able to enroll >2000 PH patients.<sup>3</sup>

**TABLE 2** Summary of most common perceived thematic barriers in PH care delivery in India.

#### Most common perceived thematic barriers in PH care delivery in India

##### *Diagnostic workup of PH*

1. Implementing low-yield tests (for treatable causes making them irreversible,) due to lack of physician awareness.
2. Lack of agreed protocol.
3. Hesitancy towards invasive procedures amongst patients and physicians.
4. Underutilization of V/Q and sleep studies, due to unavailability.
5. Lack of dedicated PH centers of excellence.

##### *Lifestyle and exercise therapy*

1. Limited availability and accessibility of supervised exercise.
2. Perception amongst physicians that it is not worthwhile.
3. Lack of awareness amongst patients about benefits of exercise therapy.

##### *Pulmonary vasodilator medical therapy*

1. Paucity of agreed guidelines for risk stratification among physicians, due to lack of physician awareness.
2. Unavailability of prostacyclins.
3. Cost of medications.

##### *Surgical and interventional therapies*

1. Limited surgeons with technical expertise and experience.
2. Lack of motivation given perception of time-consuming and high-risk nature of the procedure.
3. limited to very few centers.
4. Social stigma about organ donation in Indian culture.

##### *Palliative care*

1. Patients perceive that these invasive and expensive procedures are not worth in late stages of PH.
2. Reluctance amongst the surgeons as they perceive that these procedures are cumbersome and nonrewarding.

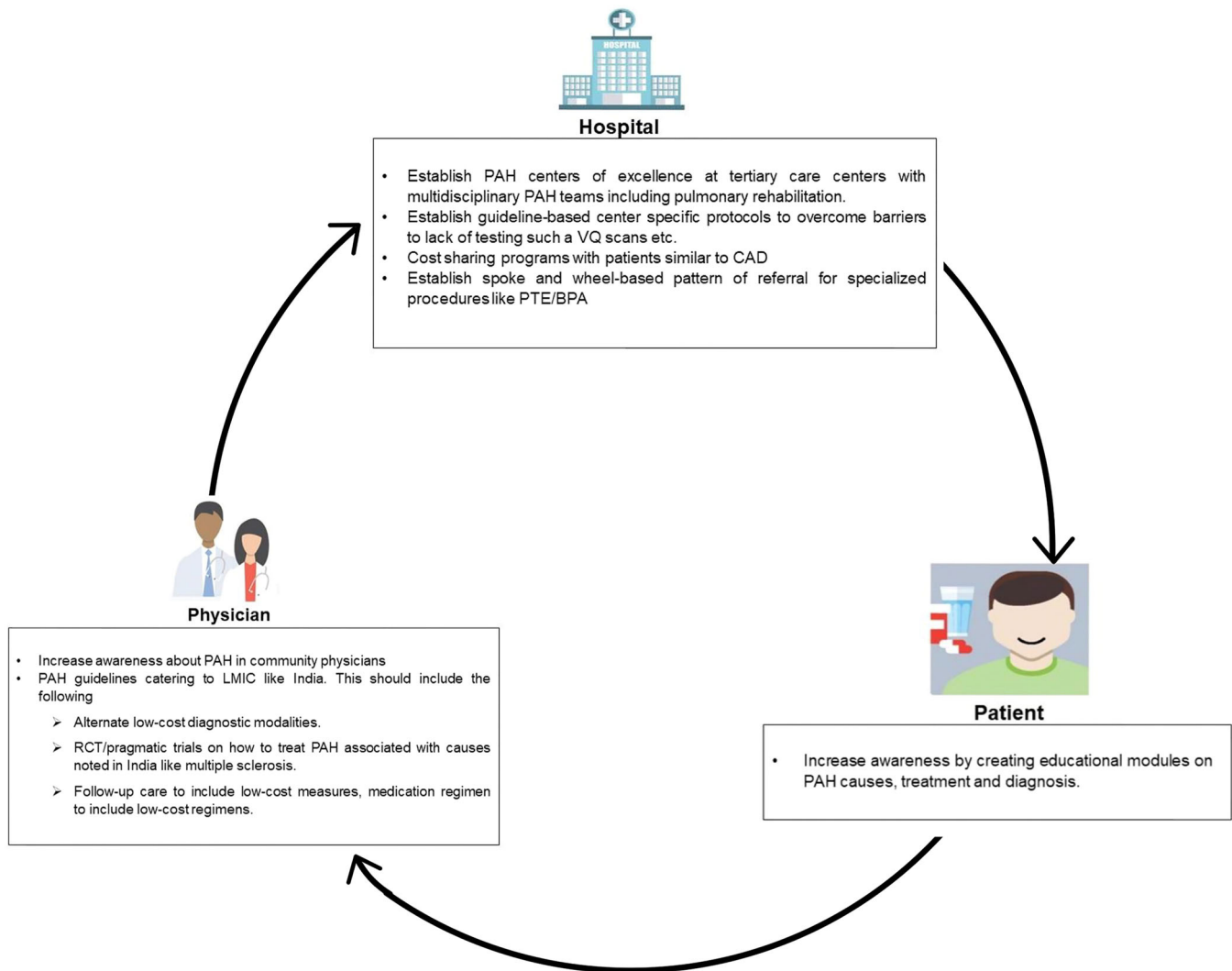
PROKELARA included all PH categories and showed that Group 2 PH was the prevalent type of PH. Within Group 1 PH, 66% of patients had associated CHD.<sup>3</sup> It is likely that PH is far more prevalent in India compared to the Western world not only due to a larger population but also due to a higher prevalence of co-morbid conditions that lead to PH such as rheumatic mitral valve disease and untreated CHD. The PROKERALA registry noted that etiology of PH is significantly different in India compared to the Western world and found that only one out of two Group 1 PH patients received pulmonary vasodilator therapies.<sup>3</sup> This likely holds true for other LMICs that account for 6.5 billion individuals globally or 84% of the total world population. Epidemiologic efforts such as PROKERALA lay the first step in making efforts to improve care for PH patients in LMIC.<sup>3,4</sup> To the best of our knowledge, our study is one of the first in systematically highlighting challenges encountered in providing care for PH patients in India and how PH care needs to be customized to LMIC where resources are limited.

Guidelines for pulmonary arterial hypertension management currently endorsed by major American and European societies center the diagnosis on hemodynamics obtained RHC through Galiè et al. and McLaughlin et al.<sup>10,11</sup> Inarguably RHC forms the gold standard for diagnosis and risk stratification of pulmonary arterial hypertension. However, in resource-restricted settings encountered in LMIC, physicians rely on other cheaper noninvasive diagnostics such as trans-thoracic echocardiography. While this is partly due to lack of advanced training in specialized fields like PH, it is also due to lack of resources. Additional studies evaluating sensitivity and specificity of echocardiograms in LMIC and establishing algorithms with populations where echocardiograms alone would suffice rather than RHC in all patients for PH diagnosis are needed. Not only would LMIC-specific guidelines provide a roadmap for physicians working in these settings, but they would also help increase general awareness on best practices and can help provide guidance for patients as well.

We observed that while nearly all oral pulmonary vasodilators are available in India; their use is limited by both financial barriers and lack of dedicated protocols on how to best use these agents. Current trials largely focus on PH treatment due to Groups 1 or 4. Not only is the etiology of PH different in LMIC, not all agents proven to be beneficial in Western world will translate into equivalent efficacy in resource-restricted settings of LMIC countries such as India. Accordingly, there is a need to conduct pragmatic trials specifically for PH in LMIC. Figure 2 highlights proposed solutions to some of the challenges we identified in PH care delivery in India.

We believe these results serve as an important first step in identifying barriers for optimum PH care delivery in India. Next, prevailing themes identified in this study





**FIGURE 2** Proposed solutions to challenges identified in PH care delivery in India.

will serve as a foundation for a quantitative inquiry amongst a larger group of PH providers in India.

## LIMITATIONS

The findings of our study should be considered in light of several considerations. First, we interviewed physicians only at larger, tertiary care centers. It is likely that answers we encountered constitute the best-case scenario as PH care in smaller, more rural setups are likely to be even more challenging and limited. However, by engaging larger centers in our study we hope to create awareness around the need to streamline and improve PH care. Second, we cannot rule out bias as our observations are based on responses obtained from physicians and not direct observation of their practice and our findings may not seem actionable at this time. However, qualitative studies such as this one help understand barriers encountered in real-world care that cannot be

estimated through quantitative studies. We attempted to minimize this bias by asking open ended questions in a nonjudgmental fashion without collecting any identifiable information to prompt candid responses. Third, we identified unavailability of RHC as a potential barrier in this study. While RHC would not necessarily be indicated in all patients with Groups 2 and 3 PH, we didn't specifically inquire about the utility of an RHC within each individual PH sub-group. Our goal was to identify barriers to optimal PH care delivery at large and RHC unavailability emerged as one such important barrier.

## CONCLUSION


Our study highlights deficits in PH care delivery in India despite the high prevalence of PH in the Indian population and the presence of well-trained physicians. While it is commonly believed to be due to lack of

financial resources, this survey emphasizes the need for education and increasing awareness as the biggest hurdle toward achieving high-quality PH care in the Indian Population. Our findings are an ideal first step towards highlighting barriers to ideal PH care delivery in a low to middle-income country like India and serve as a call to action amongst thought leaders in the medical fraternity in India on how PH care delivery is several years behind the currently accepted norm worldwide. Future efforts are expeditiously needed to improve the quality of PH care and on addressing disparities and unique challenges faced in real-world practice.

### CONFLICT OF INTEREST

The authors declare no conflict of interest.

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