

# Barriers to Climate-Health Communication Among Physicians in Pakistan and Bangladesh: A Mixed-Method Pilot Study

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## Abstract

**Background:** Physicians play a critical role in communicating climate-related health risks to patients; however, barriers to such communication in low- and middle-income countries remain insufficiently understood. This study aimed to explore physicians' perceptions, practices, and barriers related to climate-health communication in Pakistan and Bangladesh.

**Methodology:** A mixed-method pilot study was conducted using a cross-sectional survey and semi-structured interviews. A total of 124 physicians were surveyed, and 14 physicians participated in in-depth interviews. Quantitative data were analyzed to identify perceived responsibilities and barriers, while qualitative data were thematically analyzed to explore underlying perspectives.

**Results:** Most physicians (89.6%; 95% CI: 82.8–94.4) believed it was their responsibility to educate patients about climate-related health risks. The most commonly reported barriers included lack of knowledge (66.9%), time constraints (65.3%), and perceived patient disinterest (54.0%). Physicians with prior climate-related training were significantly more likely to identify patient skepticism as a barrier (adjusted odds ratio [aOR] = 3.81; 95% CI: 1.36–10.70;  $p = 0.011$ ). Qualitative analysis identified three key themes: awareness of climate change and health, barriers to effective communication, and recommendations for improving practice. Time limitations and knowledge gaps were consistently emphasized across both data sources.

**Conclusion:** Although physicians recognize their role in climate-health communication, multiple systemic and individual barriers limit effective engagement with patients. As a pilot study using convenience sampling, these findings are exploratory and warrant further validation. Strengthening medical curricula, developing standardized consultation frameworks, and implementing supportive policies may enhance climate-health communication in South Asian healthcare systems.

**Keywords:** Climate-health education; physicians; barriers; low- and middle-income countries (LMICs); mixed-methods study

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## Introduction

Physicians are uniquely positioned to communicate climate-related health risks to patients, yet evidence on barriers to such communication remains limited—particularly in South Asia, where climate impacts are most severe. Studies from high-income countries identify time constraints, knowledge gaps, and inadequate training as key obstacles (1-3), but whether these barriers apply in low- and middle-income settings is unclear. This pilot study addresses this gap by examining barriers to climate-health communication among physicians in Pakistan and Bangladesh, two countries ranking among the world's most climate-vulnerable.

Climate change poses significant threats to human health globally (4). The World Health Organization has responded by incorporating "planetary health" into its definition of health, recognising that personal health is interconnected with environmental health(5). This paradigm shift acknowledges that human wellbeing cannot be considered in isolation from the ecosystem. The 2022 Intergovernmental Panel on Climate Change (IPCC) report documents how climate



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change intensifies extreme events, biodiversity loss, and food insecurity, with significant implications for human health (6). Climate change disproportionately affects vulnerable populations particularly children, the elderly, and those with existing health inequities(7).

South Asian countries face disproportionate impacts from climate change, experiencing climate-related disasters annually with significant health implications (8). Pakistan and Bangladesh exemplify this vulnerability: on the Global Climate Risk Index, Pakistan ranked fifth and Bangladesh seventh among countries most severely affected by extreme weather events in 2021 (9).

Recent research has begun documenting healthcare workers' awareness of these threats. A cross-sectional study from India (10) and a qualitative study from Pakistan (11) showed that although healthcare workers—including doctors, nurses, and public health professionals—are aware of climate-related health effects, they face significant challenges such as inadequate knowledge, training, and resources to educate patients and communities. A recent scoping review confirmed that climate change impacts health workers globally through direct health effects, occupational stress, and increased workload demands (12). These foundational studies established that barriers exist; however, important questions remain unanswered. Specifically, do communication-specific barriers among physicians differ from the general barriers documented across the broader healthcare workforce? Whilst previous research documented awareness and general barriers among diverse healthcare professionals, the particular challenges physicians face in communicating climate-related health risks to patients—and the factors that enable or inhibit such communication—remain poorly understood in South Asia. Physicians occupy a distinctive position as primary clinical decision-makers and trusted community voices whose engagement with climate-health communication can directly influence both individual patient behaviours and health system priorities.

This pilot mixed-method study was conducted as part of a larger research initiative (13) to address these gaps. We conducted surveys and semi-structured interviews with physicians in both Pakistan and Bangladesh to achieve three aims: (1) identify the prevalence and types of barriers faced by physicians when communicating climate-related health risks to patients; (2) explore whether demographic and professional factors (age, gender, country, practice setting, prior climate training) associate with barrier reporting; and (3) understand physicians' perspectives on policy recommendations and strategies to strengthen climate-health communication in South Asian healthcare systems. By examining physicians specifically across two countries, this study provides quantitative prevalence data and qualitative insight that can inform physician-targeted interventions and policy reforms to position healthcare providers as leaders in climate-health communication and adaptation efforts.

## Methodology

### Quantitative study

We used a convenience sampling approach, recruiting physicians through institutional emails and social media platforms (WhatsApp, Facebook, Twitter, LinkedIn) during the SARS-COV-2 pandemic. This approach was necessitated by pandemic-related restrictions on in-person recruitment; while convenience sampling limits generalisability, it enabled data collection during a period when probability sampling was impractical (14). The detailed survey methodology has been described in detail elsewhere (13). The survey questionnaire was adapted from a previous validated survey that explored physicians' views on climate change (3).

The adapted questionnaire was pre-tested with five physicians (3 from Pakistan, 2 from Bangladesh) to ensure clarity, cultural appropriateness, and comprehension. Based on feedback, minor wording modifications were made to fit the South Asian context. The questionnaire was administered in English using Google Forms.

**Sample size rationale:** As a pilot study, we aimed for approximately 100-150 participants to enable preliminary estimation of barrier prevalence with reasonable precision and to test feasibility of the survey instrument, consistent with recommendations for pilot studies.

**Eligibility criteria:** Physicians needed at least a primary undergraduate medical education and employment in primary or secondary care clinics and hospitals. Participation was voluntary without incentives. To ensure anonymity, only one researcher accessed Google Forms. Each participant could complete the survey once. Fortnightly reminders were sent. Data collection concluded on 31 July 2022. We analysed surveys with a minimum 80% completion rate.

### Qualitative study

An explanatory qualitative study was conducted between September and December 2022, following quantitative data analysis. Fourteen physicians participated (8 Pakistani, 6 Bangladeshi): five interviews via Zoom and nine in-person. The purpose was to explore trends from the quantitative study requiring further investigation, such as physicians' perspectives on barriers, challenges, and policy directions related to climate-related health events.

A topic guide with three main questions was developed: (1) What are physicians' understanding of climate-related health events? (2) How do they experience discussing climate-related health events with patients? (3) What are their policy recommendations to mitigate climate-related health events? The guide was piloted with three participants to ensure clarity, consistency, and estimate interview duration.

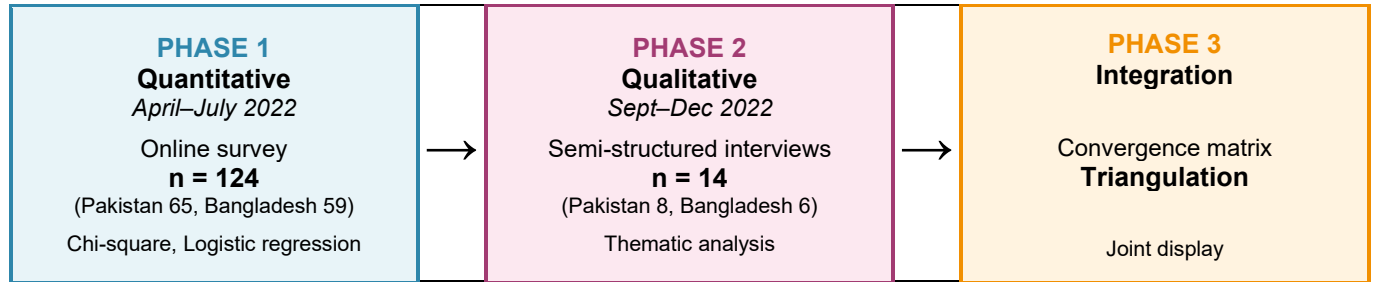
Physicians were recruited through the same channels as the quantitative study, supplemented by snowball sampling where existing participants referred others. While snowball sampling may introduce homogeneity bias as referred participants may share similar views with referrers (15), it enabled recruitment of physicians otherwise difficult to reach during the pandemic period. Each interview lasted

approximately 30-40 minutes. Prior to interviews, physicians provided informed online signed consent, saved in a separate institutional folder. Data collection continued until thematic saturation was achieved, meaning no new insights emerged from additional interviews.

**Mixed-Methods Integration:**

Quantitative and qualitative findings were integrated using a

convergence coding matrix, following O’Cathain et al.’s triangulation protocol (16). Each domain was assessed for agreement (findings from both methods support the same conclusion), partial agreement (findings partially overlap with some divergence), or disagreement (contradictory findings). This approach enabled systematic comparison of barrier prevalence from surveys with thematic emphasis from interviews.



**Figure 1: Mixed-Method Sequential Explanatory Design**

Figure 1 legend: Sequential explanatory design where quantitative findings inform qualitative exploration. Phase 1 involved online surveys with physicians. Phase 2 comprised semi-structured interviews with physicians. Phase 3 used a convergence coding matrix to triangulate findings and identify areas of agreement, partial agreement, and disagreement between datasets.

**Data analysis**

**Quantitative Data Analysis:**

Data were analysed using SPSS version 28 for data management and descriptive statistics, supplemented by Python version 3.12 (scipy and statsmodels libraries) for confidence interval estimation and regression modelling. Surveys with 80% completion rate were included. 'Don't know' responses were treated as missing.

Categorical variables were summarised as frequencies and percentages. 95% confidence intervals were calculated using the Wilson score method, which provides more accurate coverage than the Wald method for small to moderate sample sizes (17). Responses were segmented by country (Pakistan n=65; Bangladesh n=59).

Internal consistency of multi-item scales was assessed using Cronbach's alpha coefficient. Four scales were evaluated: the barriers scale (7 items), current health effects scale (12 items), future health effects scale (12 items), and perceived harm scale (5 items) (18). All scales demonstrated acceptable to excellent internal consistency (α range: 0.77-0.94).

Chi-square tests compared demographic characteristics and response patterns between countries. Binary logistic regression examined associations between demographic factors and barriers to climate change communication. Likert responses were dichotomised as agreement (Strongly Agree/Agree) versus non-agreement. Both unadjusted and adjusted odds ratios (aORs) with 95% confidence intervals are reported. Statistical significance was set at p<0.05 (two-tailed). Given the exploratory nature of this pilot study, findings should be interpreted with caution and require replication in larger samples.

**Qualitative Data Analysis:**

Qualitative interviews were transcribed verbatim by the research team (HK, TZ & FR). Thematic analysis following Braun and Clarke's framework (19) was conducted by TZ. The process involved: (1) familiarisation through repeated reading of transcripts and summarising key points, (2) generating initial codes capturing main ideas, concepts, and patterns, (3) searching for themes by grouping codes based on similarities and differences using Atlas.Ti v.7, (4) reviewing themes against research questions, and (5) defining and naming three final themes. FR and HK independently reviewed coded transcripts to validate theme identification. Three main themes emerged from the qualitative data.

Data triangulation compared qualitative and quantitative responses to gain comprehensive understanding of barriers and challenges. A convergence coding matrix was used to identify areas of agreement, partial agreement, and disagreement between datasets, enhancing the validity of findings regarding physician perspectives on climate-related health communication.

**Results**

The results are organised as quantitative results first and then the qualitative results.

**Quantitative results**

One hundred and twenty-four physicians participated in the study (65 from Pakistan, 59 from Bangladesh). The two samples differed significantly in age distribution and professional background: Pakistani physicians were predominantly older (>30 years) and trained in family medicine, while Bangladeshi physicians were younger (≤30 years) and mostly working in secondary or tertiary care hospitals (both p<0.001). Gender and practice setting did not differ significantly between countries (Table 1).

**Table 1: Demographic Characteristics of Physician Participants**

Variable	Pakistan (n=65)	Bangladesh (n=59)	p-value
<b>Age Groups</b>			<0.001***
≤30 Years	3 (4.6)	45 (76.3)	
>30 Years	62 (95.4)	14 (23.7)	
<b>Gender</b>			0.124
Male	21 (32.3)	28 (47.5)	
Female	44 (67.7)	31 (52.5)	
<b>Setting</b>			0.718
Urban	33 (50.8)	37 (62.7)	
Rural	12 (18.5)	10 (16.9)	
Both	20 (30.8)	12 (20.3)	
<b>Professional Category</b>			<0.001***
Family Medicine	54 (83.1)	5 (8.5)	

Other Clinical	11 (16.9)	54 (91.5)	
<b>Prior Climate Training</b>			0.089
Yes	28 (43.1)	17 (28.8)	
No	37 (56.9)	42 (71.2)	

Data are presented as n (%). p-values calculated using Pearson's chi-square test. \*\*\*p<0.001

The majority of physicians (89.6%) believed it was their responsibility to educate patients about health effects of climate change. The most commonly reported barriers were lack of knowledge (66.9%), lack of time (65.3%), and perceived patient disinterest (54.0%). No significant differences were observed between Pakistani and Bangladeshi physicians for any item (Table 2).

**Table 2: Physicians' responses on their beliefs about communication with patients about climate-related health issues**

Item	Pakistan n (%), 95% CI	Bangladesh n (%), 95% CI	Total n (%), 95% CI	p-value
Responsibility to educate patients	58 (89.2, 79.8-95.0)	54 (90.0, 79.9-95.9)	112 (89.6, 82.8-94.4)	0.89
<b>Barriers to addressing climate-related health issues:</b>				
Disbelief that climate change is happening	11 (16.9, 9.6-27.8)	10 (16.7, 9.0-28.0)	21 (16.8, 11.1-24.3)	0.96
Belief that patients are not interested	33 (50.8, 38.6-62.9)	34 (57.6, 44.7-69.5)	67 (54.0, 45.2-62.7)	0.43
Lack of time	41 (63.1, 50.6-74.1)	40 (67.8, 55.0-78.4)	81 (65.3, 56.5-73.2)	0.57
Lack of knowledge on climate-health issues	46 (70.8, 58.6-80.7)	35 (62.5, 49.3-74.2)	81 (66.9, 58.0-74.9)	0.32
Belief that discussion won't make a difference	22 (33.8, 23.2-46.2)	26 (44.1, 31.8-57.0)	48 (38.7, 30.4-47.6)	0.23
Not a billable activity	15 (23.1, 14.5-34.6)	20 (33.9, 23.1-46.6)	35 (28.2, 21.1-36.7)	0.26

Data are n (%), 95% CI). 95% CI calculated using Wilson score method.

Physicians anticipated that forest fires (59.8%), healthcare service disruptions (54.3%), and violence/conflict (51.0%) would most affect patients in the next 10-20 years (Table 3).

**Table 3: Physicians' Perceptions of Climate Change Effects on Patients in Next 10-20 Years**

Health Effect	Pakistan n (%)	Bangladesh n (%)	Total n (%), 95% CI	p-value
Physical/mental harm from forest fires	42 (64.6)	33 (55.0)	75 (60.0, 51.2-68.2)	0.36
Heat-related effects	30 (46.2)	23 (38.3)	53 (42.4, 34.1-51.2)	0.48
Vector-borne infectious diseases	30 (46.9)	25 (42.4)	55 (44.7, 36.2-53.5)	0.75
Water and food-borne diseases	26 (40.0)	24 (40.0)	50 (40.0, 31.8-48.8)	1.00
Mental health conditions	29 (44.6)	30 (50.0)	59 (47.2, 38.7-55.9)	0.67
Physical/mental harm from droughts	30 (46.9)	28 (46.7)	58 (46.8, 38.2-55.5)	1.00
Reduced outdoor air quality	29 (44.6)	24 (40.0)	53 (42.4, 34.1-51.2)	0.73
Loss of housing from extreme weather	37 (56.9)	24 (40.0)	61 (48.8, 40.2-57.5)	0.09
Disruptions to healthcare services	37 (56.9)	31 (51.7)	68 (54.4, 45.7-62.9)	0.68
Hunger and malnutrition	30 (46.2)	25 (41.7)	55 (44.0, 35.6-52.8)	0.75
Increased poverty	28 (43.8)	25 (42.4)	53 (43.1, 34.7-51.9)	1.00
Violence and conflict	35 (53.8)	29 (48.3)	64 (51.2, 42.5-59.8)	0.66

Data are presented as n (%). Percentages represent 'little', 'moderate', or 'great deal' of impact. 95% CI (Wilson score method) shown for Total column. p-values from Pearson's chi-square test.

The majority supported large-scale prevention (49.6%) and preparedness (64.9%) efforts, identifying policy actions (29.5%) and professional education (25.5%) as priority resources (Table 4). No significant between-country differences were observed.

**Table 4: Physicians' Views on Prevention, Preparedness, and Resources**

	Pakistan n (%)	Bangladesh n (%)	Total n (%), 95% CI	p-value
<b>Prevention effort needed</b>				0.63
Large-scale, even at large economic cost	32 (49.2)	30 (50.0)	62 (49.6, 41.0-58.2)	
Medium-scale, at moderate economic cost	18 (27.7)	18 (30.0)	36 (28.8, 21.6-37.3)	
Small-scale with small economic cost	13 (20.0)	8 (13.3)	21 (16.8, 11.3-24.3)	
No effort required	2 (3.1)	4 (6.7)	6 (4.8, 2.2-10.1)	
<b>Preparedness effort needed</b>				0.26
Large-scale, even at large economic cost	41 (63.1)	40 (66.7)	81 (64.8, 56.1-72.6)	
Medium-scale, at moderate economic cost	12 (18.5)	11 (18.3)	23 (18.4, 12.6-26.1)	
Small-scale with small economic cost	7 (10.8)	8 (13.3)	15 (12.0, 7.4-18.9)	
No effort required	5 (7.7)	1 (1.7)	6 (4.8, 2.2-10.1)	
<b>Most important resource</b>				0.62
Policy actions on climate change	21 (32.3)	16 (26.7)	37 (29.6, 22.3-38.1)	
Continued professional education	18 (27.7)	14 (23.3)	32 (25.6, 18.8-33.9)	
Patient education material	5 (7.7)	3 (5.0)	8 (6.4, 3.3-12.1)	
Guidance on sustainable workplace	8 (12.3)	10 (16.7)	18 (14.4, 9.3-21.6)	
Training to communicate climate effects	12 (18.5)	17 (28.3)	29 (23.2, 16.7-31.3)	

Data are presented as n (%). 95% CI (Wilson score method) shown for Total column. p-values from Pearson's chi-square test comparing response distributions between countries.

Physicians with prior climate change training were more likely to identify climate skepticism as a barrier to patient communication (aOR=3.81, p=0.011), possibly reflecting greater awareness of resistance encountered in practice. Female physicians showed a trend toward being less likely to report that

climate discussions would not make a difference (aOR=0.50, 95% CI: 0.23-1.07, p=0.076) or that it was not a billable activity (aOR=0.45, 95% CI: 0.20-1.00, p=0.051). No other demographic factors were significantly associated with reporting barriers (Table 5)

**Table 5: Factors Associated with Barriers to Climate Change Communication**

Variable	Unadj. OR	95% CI	p-value	Adj. OR	95% CI	p-value
<b>Climate skepticism as barrier</b>						
Prior training (ref: no)	3.47	1.28-9.40	0.014*	3.81	1.36-10.70	0.011*
<b>Discussion won't help</b>						
Female (ref: male)	0.52	0.25-1.07	0.076	0.50	0.23-1.07	0.076
<b>Not billable as barrier</b>						
Female (ref: male)	0.46	0.21-1.02	0.054	0.45	0.20-1.00	0.051

\*p<0.05. Adjusted models control for age, gender, country, and prior training.

**Qualitative results**

Fourteen physicians participated in semi-structured interviews (8 Pakistan, 6 Bangladesh), with balanced representation by age (7 aged ≤30; 7 aged >30) and gender (8 male; 6 female). Most worked in urban settings (11/14) and were split between hospital (8/14) and primary healthcare (6/14) contexts. Pakistani physicians had substantially longer clinical experience (mean 16 years, range 3-30) compared to Bangladeshi physicians (mean 3.5 years, range 3-4). Data collection continued until thematic saturation was achieved (Table 6).

**Table 6: Demographics of physician participants in qualitative study**

Characteristic	Pakistan (n=8)	Bangladesh (n=6)	Total (n=14)	Range
Age ≤30 years	2	5	7	-
Age >30 years	6	1	7	-
Male	5	3	8	-
Female	3	3	6	-
Urban setting	6	5	11	-
Hospital-based	4	4	8	-
Primary care	4	2	6	-
Years experience (mean)	16	3.5	-	3-30

Demographic characteristics of 14 physicians who participated in semi-structured interviews. Pakistani physicians had substantially longer clinical experience compared to Bangladeshi physicians.

**Thematic Analysis**

Three interconnected themes emerged, consistent across both countries: (1) climate change awareness, (2) barriers to communication, and (3) recommendations for action (Figure 2). These themes aligned with patterns observed in the quantitative data, supporting triangulation of findings.

**Theme 1: Climate Change Awareness**

Most physicians (10/14; Pakistan 6/8, Bangladesh 4/6) demonstrated strong awareness of climate change impacts, describing specific environmental changes they had witnessed:

*"Climate is now unpredictable and unstable... no fixed time of rain or seasons." (Family physician, Pakistan)*

Physicians recognised connections between environmental degradation and disease patterns, particularly respiratory conditions and vector-borne diseases. A Bangladeshi physician

described indirect pathways:

*"Farmers have to use more pesticides and fertilizers which sometimes inversely affecting the quality of food and adds to environmental pollution." (Hospital physician, Bangladesh)*

However, a minority (4/14) viewed climate changes as routine seasonal variation rather than anthropogenic change, reflecting limited understanding of climate science:

*"We have four seasons that changes every three months... when there is a climate change the patient comes with different symptoms." (Family physician, Bangladesh)*

This finding converges with quantitative results showing 16.8% of physicians reported climate skepticism as a barrier (Table 2).

**Theme 2: Barriers to Communication**

Three primary barriers emerged, mirroring the quantitative findings: time constraints, knowledge gaps, and patient receptivity.

**Time constraints** were most frequently cited (11/14; Pakistan 7/8, Bangladesh 4/6), consistent with the survey finding that 65.3% reported lack of time as a barrier:

*"Physicians are always in a hurry—we do not have standardised time for the patient unlike developed countries." (Family physician, Pakistan)*

*"It is difficult to talk on climate when one has fifty patients in the waiting room." (Hospital physician, Bangladesh)*

**Knowledge gaps** about climate-health relationships were acknowledged by several physicians (8/14), aligning with the 66.9% who reported lack of knowledge as a barrier in the survey:

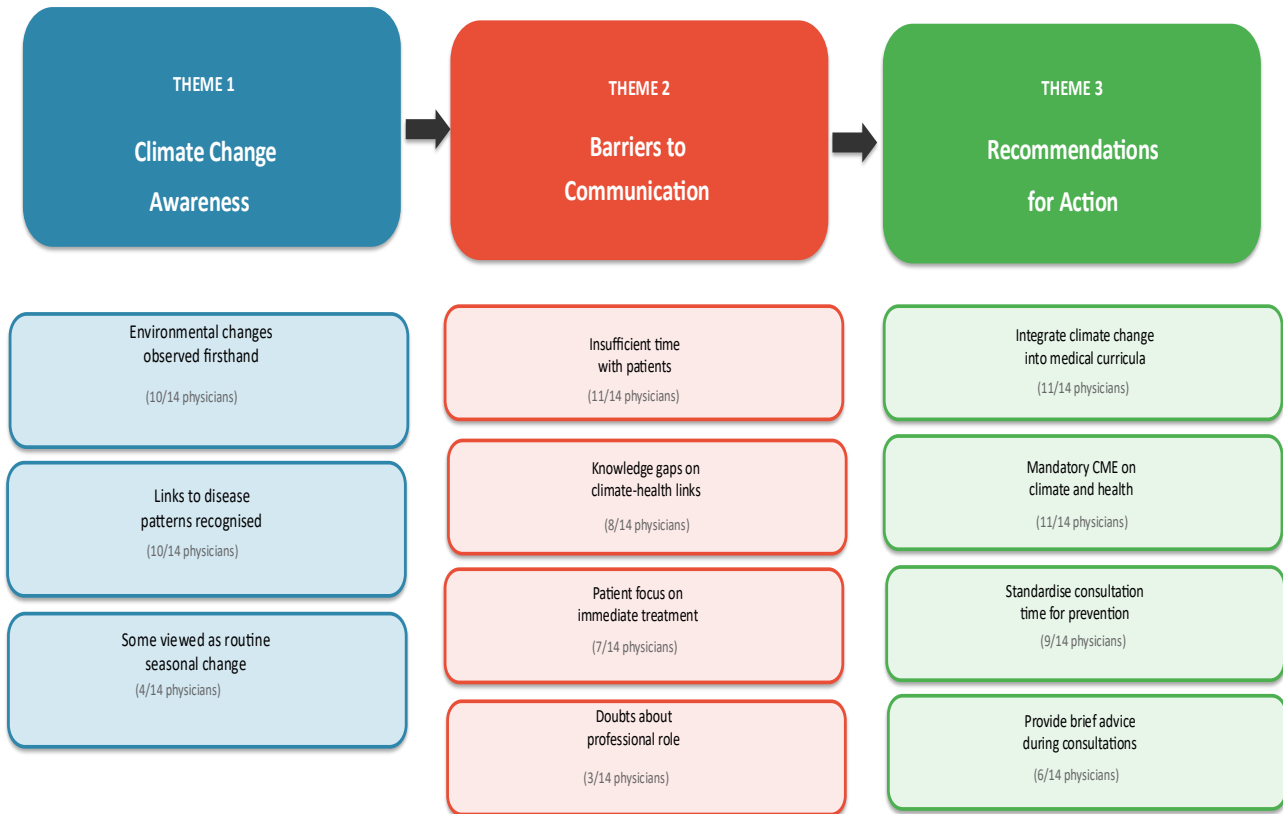
*"We need more training on how climate actually affects health... I know pollution is bad, but specifics? Not really." (Hospital physician, Pakistan)*

**Patient receptivity** presented additional challenges (7/14). Physicians described patients as focused on immediate treatment rather than prevention:

*"Patients don't have that much time... Why would people go to the hospital to hear these issues?" (Family physician, Bangladesh)*

A subset of physicians (3/14; Pakistan 1/8, Bangladesh 2/6) questioned whether climate communication fell within their professional scope, viewing it as governmental responsibility:

*"Physicians don't have any chance to reduce climate-related health issues in reality, unless the higher authorities change their policies." (Hospital physician, Bangladesh)*



Qualitative interviews with 14 physicians (Pakistan n=8, Bangladesh n=6)

**Figure 2: Thematic Framework: Physicians' Perspectives on Climate Change Communications**

Figure 2 legend: Thematic framework illustrating three interconnected themes from qualitative interviews with 14 physicians.

### Theme 3: Recommendations for Action

Despite barriers, physicians offered concrete recommendations for strengthening climate-health communication.

**Brief clinical advice** was already being incorporated by some physicians (6/14; Pakistan 3/8, Bangladesh 3/6):

*"As a primary care physician, I think I can do pretty well to reduce climate-related health problems... I can educate the patient about maintaining hygiene and drinking boiled water." (Family physician, Pakistan)*

**Medical education reform** was the most strongly endorsed recommendation (11/14; Pakistan 6/8, Bangladesh 5/6), supporting the quantitative finding that 25.5% identified continued professional education as the most important resource:

*"Compulsory CMEs for minimum of 50 hours per year for every general practitioner... and setting a standard consultation time for the doctor to see the patients is important if you want them to focus on prevention." (Family physician, Pakistan)*

This aligns with the 64.9% of surveyed physicians who supported large-scale preparedness efforts (Table 4).

### Mixed-Methods Integration

To assess the validity and complementarity of our findings, we systematically compared quantitative and qualitative results across eight key domains using a convergence coding matrix(16). Table 7 presents the convergence analysis. It demonstrates strong methodological convergence, with seven of eight domains showing full agreement between quantitative and qualitative findings. This triangulation strengthens confidence in the identified barriers—time constraints, knowledge gaps, and patient receptivity were not only reported at high prevalence in surveys but elaborated with rich contextual detail in interviews. The single partial agreement (professional scope) reflects qualitative nuance not fully captured by survey items, highlighting the value of the mixed-method approach.

**Table 7: Convergence of Qualitative and Quantitative Findings**

Domain	Quantitative Finding	Qualitative Finding	Convergence
Physician responsibility for climate-health communication	89.6% (95% CI: 82.8-94.4) believed it was their responsibility to educate patients	Most physicians (10/14) demonstrated strong awareness and recognised their role in patient education	Agreement
Barrier: Time constraints	65.3% reported lack of time as a barrier	Most frequently cited barrier (11/14); "Physicians are always in a hurry"; "difficult to talk on climate when one has fifty patients"	Agreement
Barrier: Knowledge gaps	66.9% reported lack of knowledge as a barrier	Acknowledged by 8/14 physicians; "We need more training on how climate actually affects health"	Agreement
Barrier: Patient disinterest/receptivity	54.0% reported perceived patient disinterest as a barrier	Described by 7/14; "Patients don't have that much time... Why would people go to the hospital to hear these issues?"	Agreement
Barrier: Climate skepticism	16.8% reported skepticism as barrier; trained physicians more likely to identify (aOR=3.81, p=0.011)	Minority (4/14) viewed climate changes as routine seasonal variation rather than anthropogenic	Agreement
Barrier: Not within professional scope	38.7% reported discussion won't make a difference	Subset (3/14) questioned whether climate communication was their responsibility vs government's	Partial Agreement
Support for preparedness efforts	64.9% supported large-scale preparedness; 49.6% supported prevention	Most offered concrete recommendations; 6/14 already incorporating brief clinical advice	Agreement
Priority: Medical education/training	25.5% identified professional education as most important resource	Most strongly endorsed recommendation (11/14); "Compulsory CMEs for minimum of 50 hours per year"	Agreement

Note: Convergence assessed using O’Cathain et al.’s triangulation protocol for mixed-methods integration (16). Agreement = findings from both methods support the same conclusion; Partial Agreement = findings partially overlap with some divergence in scope or emphasis; Disagreement = contradictory findings; Silence = finding present in one method only.

## Discussion

This pilot study found that while most physicians in Pakistan and Bangladesh recognise climate change as a health priority, substantial barriers hinder patient communication. Time constraints (65.3%) and knowledge gaps (66.9%) were most commonly reported, consistent with findings from previous studies (1, 2, 10-13, 20-22). These barriers align with established health communication theory, particularly the Health Belief Model's emphasis on perceived barriers influencing health-related behaviours (23); understanding how physicians perceive these barriers is essential for designing effective interventions. Notably, physicians with prior climate training were nearly four times more likely to identify patient skepticism as a barrier (aOR=3.81, p=0.011), suggesting that training increases awareness of communication challenges rather than eliminating them. Most physicians supported large-scale prevention (49.6%) and preparedness (64.9%) efforts, with policy actions and professional education identified as priorities. Qualitative findings reinforced these patterns, with time constraints and knowledge gaps emerging as dominant themes.

This paradoxical finding—where training increases rather than eliminates barrier awareness—warrants consideration. Training may heighten physicians' recognition of communication challenges they previously overlooked. Training programmes should therefore prepare physicians not only with knowledge but also with communication strategies for addressing patient skepticism.

The convergence between quantitative barrier prevalence and qualitative theme emphasis strengthens confidence in our findings. For instance, time constraints were reported by 65.3% in surveys and emerged as the most frequently discussed barrier in interviews (11/14 physicians). This methodological triangulation provides richer understanding of how barriers operate in practice.

Our findings parallel both international and regional studies. Studies conducted in France, Portugal and Nigeria revealed practitioners' reluctance to integrate climate change into clinical practice due to inadequate communication skills and insufficient evidence on interventions (1, 2, 20, 21). The barriers identified—time constraints, knowledge gaps, patient receptivity—align with global evidence, suggesting these challenges transcend healthcare system contexts. Within South Asia, complementary research provides important context. A cross-sectional study from India revealed that healthcare workers are aware of climate-related health effects but face inadequate knowledge, training, and resources to educate patients and communities (10). Subsequently, a qualitative study of diverse healthcare professionals in Karachi, Pakistan (doctors, nurses, and public health experts) identified training gaps and resource limitations as critical barriers (11). These studies establish that barriers exist across the broader healthcare workforce. However, whilst those studies examined awareness and barriers across diverse professionals, our study provides quantitative prevalence data on communication-specific barriers among physicians specifically and identifies

profession-specific factors associated with barrier reporting. By examining physicians across both Pakistan and Bangladesh, this work complements prior South Asian research and highlights the need for physician-targeted interventions.

A minority of physicians (16.8%) reported climate skepticism as a barrier, consistent with findings from other contexts where skepticism relates to cultural, religious, and political factors (24, 25). Understanding drivers of skepticism in South Asian healthcare settings warrants further investigation, potentially including engagement with religious and community leaders in climate education initiatives.

Female physicians showed trends toward greater belief in the value of climate discussions ( $p=0.051-0.076$ ), consistent with literature on gender differences in environmental concern (26). However, borderline significance and wide confidence intervals warrant cautious interpretation.

Medical education and training emerged as the most critical need. Most physicians (11/14 qualitative; 25.5% quantitative) identified medical education as a priority intervention, supporting calls for curriculum integration, confirming findings of international evidence (27-29). Georgetown University's model of embedding climate modules within respiratory medicine offers a practical approach that could extend to other clinical areas. Such integration aligns with Paris Agreement recommendations for health sector engagement (29, 30). Given that 64.9% of physicians supported large-scale preparedness efforts, there appears to be receptivity to enhanced training.

Given Pakistan and Bangladesh's severe climate vulnerability, findings underscore the need for multi-sectoral policy responses. Healthcare providers, as trusted community voices (27), represent underutilised assets for climate-health communication. Policy recommendations include standardised consultation protocols allowing time for preventive discussions; integration of climate-health content into medical curricula; and targeted communication training for practicing physicians. School curriculum integration offers additional long-term benefits. As frontline responders to climate-related health events, physicians require both knowledge and systemic support to fulfil their potential role in community health protection.

### Limitations

Several limitations warrant consideration. The cross-sectional design prevents tracking evolution of climate-health knowledge over time. The small sample size ( $n=124$  quantitative,  $n=14$  qualitative) limits generalisability and statistical power. Convenience sampling and voluntary online participation introduce selection bias, potentially overrepresenting physicians with greater climate interest or digital access. Online recruitment during the pandemic may have excluded those with limited internet access, particularly in rural areas (14). The snowball sampling component of qualitative recruitment may have introduced homogeneity bias, as referred participants may

share similar views with referrers (15). Wide confidence intervals for some associations suggest imprecision requiring cautious interpretation. The two country samples differed significantly in age distribution and professional background, potentially confounding between-country comparisons; regression analyses adjusted for these differences where possible. Future research should employ probability sampling, larger samples, and longitudinal designs to track how evolving climate impacts influence physician perspectives and practices.

### Conclusion

This pilot study provides preliminary evidence that physicians in Pakistan and Bangladesh recognise climate change as a health threat but face barriers—particularly time constraints and knowledge gaps—in patient communication. Notably, physicians with climate training showed greater awareness of patient skepticism as a barrier, suggesting training increases recognition of communication challenges. These hypothesis-generating findings highlight potential value in medical curriculum reform, standardised consultation protocols, and policy support for climate-health communication. Given the small convenience sample, findings require validation in larger, representative studies employing probability sampling and longitudinal designs before informing policy recommendations.

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### Ethical Approval:

This study received ethical approval from the institutional review committees at Public Health Foundation Bangladesh (PHF-NG-1005) and Health Services Academy, Pakistan. The study followed the World Medical Association Declaration of Helsinki (1964-updated 2014) and the International Ethical Guidelines for Biomedical Research Involving Human Subjects (2017). All participants provided informed online consent before participation.

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**Authors' Contribution:**

**TZ & HJ:** Came up with the research idea.

**HJ, AJK, HA, MFR, MHK:** Helped develop the quantitative and qualitative research instruments and helped in data collection.

**AR & TZ:** Conducted quantitative and qualitative data analysis, respectively.

**MHK, MFR & TZ:** Conducted the qualitative interviews and transcription.

**TZ:** Wrote the first draft of the manuscript.

**HJ, AJK, AR, HA, MFR, MHK:** Reviewed and edited the manuscript. All authors approved the manuscript for publication.

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