

Knowledge and experience of physicians during the COVID-19 Pandemic: A global cross-sectional study

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Abstract

Physicians are on the frontline of the COVID-19 pandemic with responsibility to manage the disease. The aim of this study is to investigate physicians' knowledge, attitudes, and preventative practices regarding the COVID-19 pandemic and COVID-19 vaccinations, as well as explore physicians' recommendations for future pandemics. A mixed-methods online survey was disseminated to physicians globally. The survey was distributed via social media from August 9–30, 2021. Data collected included sociodemographic characteristics, knowledge, attitudes, and practices towards COVID-19, concerns regarding vaccinations, and perspectives on policies implemented. Descriptive statistics were reported, and qualitative data were analysed using inductive thematic analysis. A total of 399 physicians from 62 countries completed the survey, with similar participation from High Income Countries and Low- or Middle-Income Countries. Most physicians (87%) revealed a good level of knowledge while only half (54%) reported adhering to adequate preventative measures. More than half of participants (56%) indicated that the policies implemented to handle COVID-19 by their public health agencies were insufficient or disorganised. While most physicians reported increased mental stress (61%) and described their experience with COVID-19 using negative terminology (63%), the majority of physicians (87%) indicated they are willing to continue working in healthcare. Physicians globally possessed good knowledge of COVID-19 and vaccinations; yet improvements in ensuring compliance with preventative practices is warranted. Findings from this study have important implications. As recommended by physicians, efforts to manage pandemics should involve (1) strengthening health systems, (2) minimising adverse effects of infodemics, (3) delegating decision-making roles appropriately, and (4) acknowledging global responsibility.

Introduction

Coronavirus disease (COVID-19), caused by SARS-CoV-2 virus, has so far claimed the lives of more than 4.9 million people including healthcare professionals (HCPs) [1–3]. According to the World Health Organization (WHO) more than 115,000 HCPs have died from COVID-19, leaving an irreplaceable gap in pandemic response globally [4, 5]. HCPs have been on the frontline against COVID-19, often following local, national and international preventative and treatment guidelines. Further, the response and mitigation measures to control the pandemic have been updated regularly around the world and COVID-19 vaccines have been manufactured and deployed at a rapid pace. It is therefore essential that HCPs have access to relevant updated information to protect themselves against COVID-19 and ensure appropriate patient management.

To our knowledge, previous cross-sectional studies exploring the knowledge, attitudes, and practices (KAP) of HCPs towards COVID-19 were primarily conducted within the first six months of the pandemic. Given the numerous changes to the guidelines since the beginning of the pandemic, these studies may not represent the current KAP of physicians. Furthermore, the majority of these studies were conducted within one country [6–21]. Results from a systematic review in November 2020 exploring these national studies revealed that HCPs possessed adequate knowledge of the disease and generally had positive attitudes towards the pandemic [12]. However, an updated systematic review in May 2021 demonstrated

that HCPs had poor compliance to particular safety practices [22]. One global study conducted in March 2020, revealed that HCPs had poor knowledge regarding the virus's mode of transmission and symptom onset [23]. Additionally, very few studies have been conducted on HCP's perceptions of COVID-19 vaccines. These studies were also conducted on a national level and have shown that increased knowledge is an important predictor of vaccine hesitancy among HCPs [24, 25].

This global cross-sectional mixed-methods study investigates the knowledge, attitudes, and practices of physicians towards COVID-19 disease and COVID-19 vaccines. Understanding the experiences of physicians globally can highlight gaps in policies and educational interventions that have been aimed at physicians and the public. Physicians' reflections and their recommendations for future health emergencies are also explored. Future pandemics are considered inevitable due to the presence of high-risk factors such as overpopulation, poverty, and global warming [26–29]. This study will likely inform the development of interventions that aim to support frontline health care providers during health emergencies.

Methods

Study design and population

A mixed-methods cross-sectional study using an online survey was conducted to obtain responses from physicians globally between the 9th and 30th of August 2021.

Sample size calculation

The sample size was calculated using the online RAOSOFT sample size calculator.[30] The required sample size would be at least 377 participants for a global survey with an estimated population of more than 20,000 physicians (the largest estimate possible), in addition to an anticipated response of 50%, confidence level of 95%, and 5% margin of error.

Survey instrument and scoring system

A structured questionnaire was designed on Microsoft Forms by the authors to cover important aspects of KAP of physicians. The survey instrument was initially developed based on previous surveys [8, 10, 23]. The final questionnaire (S1 File) was modified for relevance based on the most recent information from the WHO Online Resources for COVID-19, as of July 07, 2021.

The final questionnaire was divided into eight sections: (1) *Sociodemographic characteristics*; (2) *Sources of information*; (3) *Knowledge section*: a total of 16 items were designed to measure physicians' knowledge about the COVID-19 disease and vaccines. All items were single best answer questions. Correct options were assigned 1 point and incorrect options 0 points. The total knowledge score was a sum of scores. Based on Bloom's cut-off point [10], overall knowledge was categorised as good if above 60% and poor if below 60%. Cronbach's alpha coefficient for the knowledge questions was 0.936. (4) *Practice section*: five questions were used to evaluate utilisation of various preventative measures. The

three answer options included “always”, “occasional”, or “never”. The latter two were assigned 0 points, and the former was assigned 1 point. The total practice score was a sum of scores. Physician’s overall practice was categorised based on Bloom’s cut-off point [10] as good if above 80%, and poor if below 80%. Cronbach’s alpha coefficient for the practice questions was 0.638. (5) *Physicians’ perspective on vaccinations*; (6) *Physicians’ perspective on policies implemented*; (7) *Physicians’ subjective attitudes towards the pandemic*; (8) *Physicians’ personal reflections* (Describe your COVID-19 experience in one word; What are your recommendations for future pandemics?).

Content validity of the final version was assessed by three experts who specialise in the field of infection control and emergency preparedness. The survey was then pilot tested in a sample of 10 physicians to check the acceptability, clarity, readability, and relevance of all items. Physicians did not report any problems in understanding the questionnaire. On average, the survey was completed within 10 minutes. The data of the pilot study was removed from the final analysis.

Data collection

The online survey was distributed via social media using a snowballing technique [31]. The invitation letter included a brief description of the study and the URL to the survey. Physicians were identified via professional groups and academic institutions. Informed consent was obtained by participants on the first page of the online questionnaire along with clear statements that participation was voluntary and uncompensated. To ensure quality control and maximise completeness of the data, incomplete surveys and responses from non-physicians were removed from analysis.

Statistical analysis

Statistical analysis was carried out using the statistical software SPSS (Statistical Package for Social Sciences), version 22.0. Descriptive statistics were reported using means and standard deviations (SD) for continuous variables and frequency with percentages for categorical variables.

Thematic analysis

Data from the two open-ended questions was summarised using an inductive thematic analysis approach [32]. Three team members independently coded a sample of the data until a consensus was reached and a coding framework was formulated. Two members independently coded the remaining data and negotiated agreements on discrepant codes. Three members reviewed the codes, sorted codes into descriptive categories based on patterns, and subsequently grouped descriptive categories to generate major themes.

The study was approved and given favourable ethics opinion by the St George’s, University of London Research Ethics Committee (SGREC) under study title “Knowledge and Perspectives of Health Care Providers on COVID-19: A Global Cross-Sectional Study” with REC Reference: 2021.0127. The overall study was guided by the STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) Statement for cross-sectional studies [33].

Results

Baseline characteristics of the study participants

Table 1 summarises participant characteristics. A total of 411 HCPs participated in our survey, 399 of whom were physicians, including 224 (56%) male, and 174 (44%) female. The majority were between 46–55 years old (n = 108, 27%), and practising in internal medicine (n = 80, 20%), surgery (n = 80, 20%), or general practice (n = 72, 18%). Most physicians had been practising medicine for 10 years or longer (n = 292, 73%) and most respondents identified as frontline workers (n = 268, 67%). Physicians from 62 unique countries responded to the survey, with similar participation from High Income Countries (n = 214, 54%) and Low- or Middle-Income Countries (n = 185, 46%), as identified by the World Bank [34]. Figure 1 provides a visual representation of respondents per country.

Figure 1. Visual representation of responses by country (n = 399). This map depicts the countries from which responses were received. More than 20 responses were received from countries shaded in red (Canada, United States of America, Spain, United Kingdom, Lebanon, Philippines). The dark orange indicate that 11 to 20 physicians responded from that country, whereas the light orange shade indicates that 5 to 10 physicians from that country responded to the survey. Less than 5 responses were received from countries shaded in yellow. No responses were received from countries in grey.

Table 1
Participant Characteristics (N = 399).

Participant Characteristic	N (%)
Sex	
Female	174 (43.6)
Male	224 (56.1)
Other	1 (0.3)
Age	
< 25 years old	4 (1.0)
25–35	75 (18.8)
36–45	88 (22.1)
46–55	108 (27.1)
56–65	91 (22.8)
66–75	30 (7.5)
> 75 years old	3 (0.8)
Specialty	
Internal Medicine	80 (20.1)
Surgery	80 (20.1)
General Practice	72 (18.0)
Paediatrics	54 (13.5)
Obstetrics and Gynaecology	19 (4.8)
Emergency Medicine	15 (3.8)
Psychiatry	12 (3.0)
Radiology	12 (3.0)
Intensive Care Unit	10 (2.5)
Anaesthesiology	9 (2.3)
Family Medicine	7 (1.8)
Public Health	5 (1.3)
Other	24 (6.0)
Frontline Worker Status	

Participant Characteristic	N (%)
Yes	268 (67.2)
No	131 (32.8)
Years of Experience	
≥ 10 years	292 (73.2)
< 10 years	107 (26.8)
Place of Work	
Public Establishment	247 (61.9)
Private Establishment	152 (38.1)
Country of Residence	
High-Income Country	214 (53.6)
Low- or Middle-Income Country	185 (46.4)

Sources of knowledge

Primary sources of knowledge amongst respondents were News Media and Official Government Websites (Table 2). Most physicians (51%) indicated Official Government Websites as their most-used source. The majority of respondents (43%) indicated social media as their least-used source.

Table 2
Sources of Information (N = 399).

Response	Source of COVID-19 Information N (%)			
	News Media	Social Media	Official Govt. Website	Family member or colleague
Least Used	70 (17.5)	172 (43.1)	14 (3.5)	126 (31.6)
Sometimes	147 (36.8)	116 (29.1)	58 (14.5)	165 (41.4)
More Used	117 (29.3)	63 (15.8)	120 (30.1)	87 (21.8)
Most Used	65 (16.3)	48 (12.0)	207 (51.9)	21 (5.3)

Assessment of physicians' knowledge towards COVID-19 virus and vaccines

Of all physician respondents, 349 (87.5%) participants had good knowledge about COVID-19 disease and COVID-19 vaccines (Table 3). Poor knowledge was observed for questions concerning the nature of disease (52%) and treatment of disease (59.9%). Conversely, good knowledge was observed in responses regarding transmission of disease (71.5%), actions dealing with cases (72.5%), and nature of vaccines

(89.5%). The mean total knowledge score was 11.07 (SD = 1.49). No differences between various physician specialties, frontline worker status, or residency in LMIC versus HIC were observed.

Table 3
Physician's Responses Regarding Knowledge of COVID-19 and Vaccines (N = 399).

Knowledge Items	Physicians' Answers	
	Correct N (%)	Incorrect N (%)
Nature of the disease (52.0%)		
K1: What is the incubation period of COVID-19?	200 (50.1)	199 (49.9)
K2: COVID-19 origin is thought to be from:	120 (30.1)	279 (69.9)
K3: The COVID-19 variants have different clinical manifestations.	122 (30.6)	277 (69.4)
K4: What are the complications of COVID-19?	388 (97.2)	11 (2.8)
Transmission of the disease (71.5%)		
K5: COVID-19 transmission occurs through	185 (46.4)	214 (53.6)
K6: The UK and Indian variants of COVID-19 spread faster as they are more transmissible or infectious.	386 (96.7)	13 (3.3)
Actions in Dealing with Suspected, Probable, and Confirmed Cases (72.5%)		
K7: The use of personal protective equipment is necessary during aerosol production procedures, such as suction sputum sampling and intubation.	397 (99.5)	2 (0.5)
K8: Suspected cases of COVID-19 infection after triage should be taken into care in a negative pressure respiratory isolation room.	105 (26.3)	294 (73.7)
K9: The use of N95 masks is necessary when sampling of induced sputum from patients suspected of COVID-19 infection.	366 (91.7)	33 (8.3)
Treatment of Disease (59.9%)		
K10: Oxygen therapy should be given to all cases of severe COVID-19 with acute respiratory infection.	287 (71.9)	112 (28.1)
K11: High doses of systemic corticosteroids should be avoided in patients with confirmed or suspected COVID-19 infection and clinical manifestations of viral pneumonia.	90 (22.6)	309 (77.4)
K12: What is the treatment for COVID-19?	343 (86.0)	56 (14.0)
Nature of Vaccines (89.5%)		

Knowledge Items	Physicians' Answers	
	Correct	Incorrect
	N (%)	N (%)
K13: Which of the following is not a common (i.e., less than 1% chance) side effect of COVID-19 vaccines:	381 (95.5)	18 (4.5)
K14: Individuals who are immunodeficient and/or pregnant can receive the COVID-19 vaccine.	364 (91.2)	35 (8.8)
K15: Children below the age of 12 can receive the COVID-19 vaccine.	293 (73.4)	106 (26.6)
K16: The COVID-19 vaccines that are currently in development or have been approved are expected to provide at least some protection against new virus variants.	391 (98.0)	8 (2.0)

Assessment of physicians' practice towards COVID-19

Table 4 summarises preventative practices against COVID-19. Of the 399 respondents, 214 (54.1%) reported adequately adhering to preventative measures while working. The most prevalent practise among physicians was Item 3: I wash my hands with soap or rub my hands with hydro-alcoholic gel during my work shift (94.2%). Conversely, less than half of all respondents reported wearing gloves (Item 2) while working (39.6%). The mean score for overall preventative practices towards COVID-19 is 3.47 (SD = 1.18).

Table 4
Physicians' responses regarding preventive practices towards coronavirus (N = 399).

Practice Items	Physicians' Response		
	Never	Occasionally	Always
	N (%)	N (%)	N (%)
P1: I wear a mask while performing my job	2 (0.5)	23 (5.8)	374 (93.7)
P2: I wear gloves while performing my job	37 (9.3)	204 (51.1)	158 (39.6)
P3: I wash my hands with soap or rub my hands with hydro-alcoholic gel during my work shift	3 (0.8)	20 (5)	376 (94.2)
P4: I put my PPE on in the following order: 1- gown, 2- mask, 3- gloves.	79 (19.8)	84 (21.1)	236 (59.1)
P5: I remove my PPE in the following order: 1- gloves, 2- do hand hygiene, 3- gown, 4- mask	93 (23.3)	65 (16.3)	241 (60.4)

Physicians' perceptions towards COVID-19 vaccinations

Most physicians (63%) indicated being worried about distribution of vaccines to the general population and half (50%) were concerned with the long-term side effects of vaccinations (Fig. 2). Table 5 summarises physicians' perceptions towards the COVID-19 vaccines. The majority of physicians (n = 283, 71%) indicated Pfizer-BioNTech as most effective; while 195 (49%) physicians indicated that the AstraZeneca (Covishield and Vaxzevria) vaccine has the highest risk for complications, followed by the Janssen (n = 39, 9.8%) and Sputnik V (n = 38, 9.5%) vaccines. Most physicians (96%) indicated having received the COVID-19 vaccine; only 10% of physicians were/are hesitant to receive a vaccine.

Figure 2. Physicians' perceptions during the COVID-19 pandemic. Physicians' perceptions (n = 399) regarding (a) various COVID-19 vaccine concerns and (b) policy actions implemented for the COVID-19 pandemic by their public health agencies and health care facilities.

Table 5
Summary of physicians' perceptions towards the COVID-19 vaccines (N = 399).

Item	N (%)
Vaccine with Highest Efficacy	
Pfizer-BioNTech	283 (70.9)
Moderna	47 (11.8)
AstraZeneca (Covishield and Vaxzevria)	29 (7.3)
Janssen (Johnson and Johnson)	8 (2.0)
Sputnik V	7 (1.8)
Other	25 (6.3)
Vaccine with Highest Potential for Complications	
AstraZeneca (Covishield and Vaxzevria)	196 (49.1)
Janssen (Johnson and Johnson)	39 (9.8)
Sputnik V	38 (9.5)
Sinopharm	23 (5.8)
Sinovac Biotech	23 (5.8)
Pfizer	20 (5.0)
Moderna	9 (2.3)
Other	51 (12.8)
Vaccination Status	
Yes	381 (95.5)
No	13 (3.3)
Do not want to answer	5 (1.3)
Vaccine Hesitancy	
No	259 (90.0)
Yes	40 (10.0)
Health System Efficacy in Procuring/Distributing Vaccines	
Yes	250 (62.7)
No	149 (37.3)

Physicians' perceptions towards policies aimed at tackling COVID-19

While most physicians (60%) indicated that policies implemented by their healthcare facility were adequate in handling COVID-19, only 42% specified that the policies implemented by their public health agencies were adequate (Fig. 2).

Assessment of physicians' attitudes towards COVID-19

With regards to attitudes (Table 6), high ratings of agreement (i.e., $\geq 50\%$ agreement) were reached regarding questions of increased workload (Item 3), subjective mental stress (Item 4), worrying about the future (Item 8), and fear of contracting the virus and passing it on to family or friends (Item 9). Importantly, most physicians ($n = 247$, 87%) indicated that they are willing to continue working in the health system after the pandemic (Item 10).

Table 6
Summary of physicians' attitudes towards COVID-19 (N = 399).

Item	Strongly Disagree N (%)	Disagree N (%)	Neutral N (%)	Agree N (%)	Strongly Agree N (%)
Q1: I am afraid of working in places where patients suspected of COVID-19 infection are admitted/cared for.	83 (20.8)	124 (31.1)	91 (22.8)	79 (19.8)	22 (5.5)
Q2: I am afraid of treating a patient with COVID-19 infection.	100 (25.1)	129 (32.3)	69 (17.3)	75 (18.8)	26 (6.5)
Q3: The COVID-19 pandemic has led to an increase in my daily workload	22 (5.5)	73 (18.3)	83 (20.8)	127 (31.8)	94 (23.6)
Q4: Due to the COVID-19 pandemic I feel mentally strained	25 (6.3)	45 (11.3)	86 (21.6)	167 (41.9)	76 (19.0)
Q5: Since the outbreak of the COVID-19 pandemic, the satisfaction with my job has worsened	40 (10.0)	104 (26.1)	105 (26.3)	104 (26.1)	46 (11.5)
Q6: I feel left alone by the responsible political decision-makers	36 (9.0)	100 (25.1)	108 (27.1)	99 (24.8)	56 (14.0)
Q7: Due to the COVID-19 pandemic, I have significantly less time for my personal life	30 (7.5)	105 (26.3)	94 (23.6)	118 (29.6)	52 (13.0)
Q8: Due to the COVID-19 pandemic, I am worrying more often about the future	33 (8.3)	58 (14.5)	89 (22.3)	155 (38.8)	64 (16.0)
Q9: I fear that due to my daily exposure to COVID-19 at work I could pass it on to my friends or relatives	27 (6.8)	69 (17.3)	69 (17.3)	167 (41.9)	67 (16.8)
Q10: I will continue to work in the healthcare area after the COVID-19 pandemic	8 (2.0)	8 (2.0)	36 (9.0)	153 (38.3)	194 (48.6)

Physicians' experiences of COVID-19

A total of 389 participants responded to the question: Describe your experience with COVID-19 in one word. A total of 168 unique words were organised under 20 descriptive subthemes and subsequently grouped into three major themes, namely (1) Negative experience (n = 253, 65%), (2) Positive experience (n = 23, 6%), and (3) Neutral experience (n = 113, 29%). Table 7 summarises the thematic analysis of physician experiences. Figure 3 presents a visual representation of physicians' experiences of COVID-19 (n = 389) one-word descriptions.

Figure 3. Visual representation of physicians' experiences with COVID-19: one-word descriptions (n = 389).

This word cloud depicts physician's responses regarding their experience with COVID-19 pandemic. The bigger and bolder the word appears, the more often it was mentioned among responses. Responses were thematically analysed into three distinct themes: Negative Experiences (n = 253, 65%), Positive

Experiences (n = 23, 6%), and Neutral Experience (n = 113, 29%). The top three most utilized words were “Exhausting” (n = 30), “Challenging” (n = 27), and “Stressful” (n = 22). See Table 7 for all responses.

Table 7
Summary of thematic analysis of physicians' experiences with COVID-19 (N = 389).

Theme	Sub-theme (N)	Words
Negative Experience	All-Consuming (91)	Anxiety (3), Worrying (3), Draining (6), Exhausting (30), Fatigue, Overwhelming (5), Strenuous (3), Stressful (22), Taxing (2), Tiring (9), Tough, Trying, Fight for life, Long (2), Never-ending (2)
	Appalling/Agony (37)	Suffering, Awful (3), Bad (10), Burden (2), Detrimental, F****D, Hell (2), Horrible (8), Miserable, Painful, Shattering, Terrible (5), Worse
	Resentment (23)	Anger, Annoying (3), Boring (4), Disappointing (5), Disturbing, Frustrating (7), Irritated, Inconvenient
	Depressive (20)	Death, Depressive (2), Disheartening, Distressing, Gloomy future, Grieve, Helpless, Hopeless, Joyless, Mental break down, Regrettable, Sad (6), Unpleasant, Resignation
	Frantic (20)	Chaotic (9), Claustrophobic, Clusterfuck, Disruptive (3), Hectic, Panic (2), Pressure-filled, Risky, Impatience
	Fear (18)	Afraid, Fear (9), Frightening (4), Horrifying, Scared, Terrified (2)
	Uncertainty (14)	Concerning (4), Confusing (5), Doubt, Turbulent, Uncertain (3)
	Catastrophic (11)	Devastating, Apocalyptic, Tsunami, Unimaginable, Unrelenting, War, Disaster (5)
	Inadequate (11)	Behind, Discrimination, Disproportionate, Ignorance, Insufficient (2), Uncoordinated, Unprepared, Carelessness, Disorganized (2)
	Seclusion (8)	Disconnected, Isolated, Lonely (2), No contact, Removed, In silos, Sheltered
Positive Experience	Worthwhile (11)	Excellent, Good (6), Love frontline work, Perfect, Positive
	Illuminating/Revealing (10)	Amazing, Hopeful, Awakening, Enlightening (3), Extraordinary, Fascinating (2), Insightful
	Beneficial (2)	Helpful, Useful
Neutral Experience	Demanding (35)	Difficult (6), Hard (2), Challenging (27)
	Unparalleled (23)	Spiritual, Interesting (4), Life-changing (2), Revolutionary, Strange, Surreal (2), Unique, Unknown, Unprecedented, Vicarious, World-changing, Wow, Humbling, Surprise, Unexpected, Shocking, Touching, Mystical
	Adequate (14)	Fair (2), Fine, Not bad, Okay, Satisfactory (3), Mixed, Neutral (2), Expected (2), Life

Theme	Sub-theme (N)	Words
	Significant/Substantial (13)	Rich, Serious (2), Extensive, Intense (4), Strong, Cautious (2), Only the beginning, Worldwide
	Physicians' Duty (11)	Commitment, Opportunity, Primary care experience, Responsibility (2), Telehealth, Work Load, Frontline, Experience, PPE, Politics
	Adjustment (10)	Adaptation, Change (2), Getting used to it, Lessons, Resilience, Coping well, New (3)
	Immersive (7)	Active, Busy (2), Dynamic, Hustle, Rollercoaster, Rapid

Physicians' recommendations for future pandemics

A total of 387 participants responded to the question: What recommendations do you have for future pandemics? Inductive thematic analysis of responses revealed twenty-seven distinct subthemes organised into seven major themes, described below. Table 8 summarises physicians' recommendations, and S1 Fig provides detailed codes and exemplar quotes from the thematic analysis.

Table 8
Summary of thematic analysis of physicians' recommendations (N = 387)

Theme	Summary
Holistic Preparation	Physicians acknowledged the importance of preparing for future pandemics through education, prevention, proactive planning, and pre-emptive policy development and implementation.
Execution of Response Measures	Physicians expressed the need of recognizing pandemics, implementing better guidelines, minimizing response time, adequately implementing response measures, in addition to improvements in surveillance and vaccination.
Health System Strengthening	Physicians recognized the cracks in our current healthcare system and recommended strengthening the infrastructure, promoting transparency, and one that does not operate for profit.
Appropriate Delegation of Roles	Physicians observed a need to allow individuals to perform within their designated roles when managing pandemics.
Minimize Infodemics	Physicians indicated the importance of minimizing the spread of misinformation during pandemics by improving communication in addition to ensuring the distribution of credible information.
Global Responsibility	Physicians acknowledged the importance for global unity when managing global outbreaks and establishing pandemic-resistant global health systems.
Uncertainty	A few physicians were uncertain about providing recommendations or expressed limitations of their role as a physician in being able to provide recommendations.

Theme 1: Holistic preparation

This theme represents preparing for future pandemics through education, prevention, and pre-emptive policy development and implementation. Physicians called for “more research” on pandemics and ensuring that the public, politicians, and interdisciplinary medical teams were continuously educated on the risks of a pandemic. One physician recommended to “build specific structures against pandemics”, while another suggested to “minimize human-animal interactions”. Mostly however, physicians specified to “learn from mistakes” and “ensure that any knowledge gained from the past is applied proactively for future pandemics”. One physician voiced the need to “have a better pandemic preparedness strategy, don’t wait for the 2nd/3rd wave” and another revealed “now is the time to prepare”. Other physicians expressed the need for “good, comprehensive, consistent, and integrated policy since the start”.

Theme 2: Execution of response measures

This theme included actionable items relating to pandemic response and highlighted the importance of attending to the emotional wellbeing of people. On the threat of the pandemic, physicians pointed out the need for “less denial” and to “take it seriously earlier”. Others revealed the need for accountability: “the country responsible for the outbreak must take responsibility and admit”, “punish the countries that spread such viruses”. Some physicians (n = 9, 2%) called for clear and standardised guidelines, “have a manual of operation and follow it”. However, a need for flexibility was also voiced, “allow MDs to treat patients according to their judgement and do not limit them to strict guidelines”. Additionally, physicians proclaimed a need to “act quickly and definitively” and “be rapid and safe in your response”. Some physicians noted the need for “early diagnosing, tracing, and isolating cases”. Others recommended implementing stricter protective measures stating: “quarantines should be stronger”, “earlier ban in travel”, “extreme lockdowns during early phase”, and “mask mandates”. Physicians also suggested that “hospital[s] should reorganize wards and segregate COVID positive versus negative to minimise spread of infection” and to “increase ICU beds”. Physicians expressed the need for local decision making, “decision-making at the local and state levels according to the degree of incidence”. A portion of physicians agreed on the significance of vaccinations, recommending better accessibility, compliance, and distribution of vaccinations. They noted a need for the world to “achieve herd immunity through vaccination” and some called for “mandatory vaccination”. Physicians also recommended addressing the morale of the public: “don’t panic”, “be realistic”.

Theme 3: Health system strengthening

Physicians recommended for health systems with stronger infrastructure and comprehensive resources for its physicians. Physicians also called for a health system that prioritises “physician health and safety” and promotes transparency among its constituents. Some physicians voiced a need for the health system to employ an interdisciplinary approach: “We should have programs that cover the entire spectrum from physical, psychological, social, and spiritual health as a continuum”. Another physician highlighted the “need to develop medical infrastructure in low-income countries”. Physicians suggested having a system that allows for “decentralized participatory planning on part of government agencies”. Physicians also communicated the need for a health system that is “not business oriented” and “invests more in mental health and financial support of entire population”. To strengthen the health system,

physicians expressed a demand for adequate material resources (e.g., “have adequate stock of PPE”), additional human resources (e.g., “provide more trained manpower”), “improve epidemic control centres”, and an “established task force all year round”.

Theme 4: Appropriate delegation of roles

Physicians specifically highlighted the role of politicians and their responsibility to form a more “empathetic political system” that can respond to the pandemic. Physicians (n = 34, 7%) stated a need to differentiate the role of science and healthcare professionals from the role of politicians. This was recommended particularly during policy-development, “strengthen the position of the clinicians in the decision-making”. On several occasions, physicians recommended the need for “less politics, more science”, that “policymakers should listen more to health professionals”, and that “politicians should stop managing what they can barely comprehend”. Additionally, physicians recommended, “put public health physicians and epidemiologists at the front”. Other physicians focused on the role of the WHO and the need to “re-organize it”.

Theme 5: Minimise adverse effects of infodemics

This theme captures physicians' input towards minimising the spread of misinformation. Physicians particularly called for “much better and more timely public health communications needed” and to “improve social communication to avoid fake news”. Physicians stated a need to ensure that the content of information distributed is relevant and credible, “Prevent fake news from spreading, if possible. People believe it.” With regards to inter-departmental communication, physicians recommended standardising and/or centralising the distribution of pandemic-related communications, “One central body and not 50 different emails about the same advice from different departments”. On the role of communication with the public, “Don't let social media give information to the public without peer review. The information system must be more open (data access) but it is necessary to identify the right communicator.”

Theme 6: Global responsibility

This theme encompasses physicians' views on the significance of global unity during pandemics. Physicians recommended global action through “better planning with pandemic resistant health systems”. Physicians also indicated the necessity for global transparency, one wrote: “China did respond too slowly and did not communicate about the severity of the situation and did not react to control outbreak”. Physicians also emphasised a need for “global coordination, solidarity, and equity”, and stated that “the world needs to learn to work together”. Additionally, physicians specified demands for a “global initiative to reduce social inequality” and “equitable vaccine distribution all over the world”.

Uncertainty

Few physicians expressed uncertainty towards providing recommendations, stating they were “unsure”. Other participants acknowledged the limitations of their role in being able to provide recommendations, one respondent explicitly noted “I'm not a public health expert!”.

Discussion

The results of this global survey revealed international agreement on the burden of care experienced by physicians during the COVID-19 pandemic and particularly when working in unprepared communities or institutions. Results indicated that most physicians possessed good knowledge of COVID-19 disease yet poor adherence to safety measures. Physicians were particularly concerned about the distribution of vaccines to the general population, and approximately one third indicated that the policies implemented by their healthcare facilities and public health agencies were insufficient in handling the pandemic. Although most physicians described their experience with COVID-19 in negative emotive language and agreed that the pandemic had led to increased mental stress, most were willing to continue working in the healthcare sector post-pandemic.

Most physicians in this study possessed good overall knowledge of COVID-19; this is in line with previous studies [35–37]. Additionally, physicians relied on official government websites as their primary source of information, as supported by an earlier study among HCPs [23]. This suggests that physicians have been consistently utilising reliable sources to acquire information regarding COVID-19 and correlates with the good knowledge observed. However, respondents in this study exhibited poor knowledge on domains relating to the nature and treatment of disease. Previous studies on this are inconsistent, with some physicians displaying good knowledge of the disease [38] and others showing poor knowledge [39]. The discrepancy between studies could be due to differences in programmes delivered by health facilities in supporting and educating physicians, reduced accessibility to evidence-based information in some settings, as well as differences in national-level protocols for the management and treatment of disease.

Almost all physicians in our study indicated that they have received the COVID-19 vaccine, and only a small portion were/are hesitant to receive the vaccine. The degree of vaccine hesitancy among this population of physicians is echoed in other studies [40]. Additionally, about half of physicians in this study were concerned about the rapid development of vaccines. Data from HICs suggests the rapid pace of vaccine development as one of the primary reasons for vaccine hesitancy [41].

COVID-19 revealed a lack of adequate policies, preparedness, and education necessary to combat a pandemic and control further outbreaks [42–44]. Further, the implementation of rapid pandemic control measures was at times delayed [45]. Our results indicate that the policies and actions implemented by healthcare facilities and public health agencies were insufficient and many physicians recommended a need to strengthen healthcare and political systems to better respond to pandemics. Previous studies support such recommendations, especially for evidence-based policy-making as a means to bridge the gap between clinical science and policy during the pandemic [46–49]. It is also recognised that policies to combat infectious disease outbreaks must be implemented rapidly while also meeting the needs of multiple sectors including public health, economy, and social welfare [50]. Implementing a One Health approach, recommended in this study, is crucial as the efforts of one sector, or many sectors working in silos, cannot eliminate the threat of a pandemic. As suggested by physicians in this study, the WHO has a unique responsibility in helping countries, especially LMICs, prepare for pandemics, as well as supporting

efforts to initiate and mount an effective response. These recommendations highlighted the significance of early detection, risk communication with vulnerable groups, strategies for containment, and international collaboration [51].

The spread of misinformation during previous pandemics led to confusion, risk-taking behaviours, and mistrust between the public and healthcare professionals [52–54]. Furthermore, within a highly digital society, the risks of ‘infodemics’ could be dependent on effective communication strategies that counter unreliable news [55]. Hence, the recommendations in this study for better communication strategies are much warranted.

The call for global unity during pandemics, echoed by physicians in this study, is also essential. According to the Global Dashboard for Vaccine Equity, as of December 29, 2021 only 10.28% of individuals in low-income countries have been vaccinated with at least one dose, in comparison to 67.08% in high-income countries [56]. The continued inequitable vaccine distribution leaves millions of individuals vulnerable to being infected by COVID-19 and promotes the emergence and subsequent spread of deadly variants across the globe.

Conclusion

This study suggests that physicians may need to have a more dominant role in policymaking in addition to their role as clinical experts. Given that future pandemics are inevitable,[57] exploring how and in what capacity clinicians will contribute to policy-making processes during health emergencies could be crucial. Physicians recommended a strong need to:

1. Strengthen health systems by preparing the healthcare sector for future pandemics; suggestions included to (a) invest in virology research, (b) train HCPs, (c) develop guidelines pre-emptively, and (d) arrange an emergency stockpile of material resources for clinicians.
2. Prevent infodemics by having healthcare professionals collaborate with politicians and social media outlets to guarantee that credible information is being sourced to the public.
3. Delegate decision-making roles appropriately, by promoting an empathetic political system that understands the need for input from scientists and HCPs in dictating best-practices for pandemic management.
4. Acknowledge global responsibility and the necessity for international collaboration and equity. This must be done by collaborative preparation and prevention as well as through the equitable distribution of resources.

We acknowledge the following limitations. Online surveys pose specific challenges including the inability to calculate response rate, potential for the data to not be representative, and due to being self-reported it is also prone to recall bias. Snowballing may have also introduced bias, as participants identified in that way may share similar opinions [31]. Moreover, the survey does not account for local differences in pandemic response and management. Additionally, the results may not reflect the new knowledge acquired after the study, in particular the emergence of the Omicron variant. However, as new variants

continue to emerge, the recommendations that physicians have expressed should be taken into consideration when developing guidelines. Lastly, the survey was designed and written in English, potentially introducing response bias. However, this is the first up to date mixed-method global study, to our knowledge, with a large sample size (399 physicians) in 62 unique countries including high and low- and middle-income settings. The survey questionnaire was also developed based on the most recent information from the WHO and was subsequently validated and piloted prior to distribution. Additionally, this study included both quantitative and qualitative findings, ensuring that the results obtained are grounded in participants' experiences and allowing for better translation and implementation of population and behavioural research [58, 59].

Declarations

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References

1. World Health Organization. Timeline of WHO's response to COVID-19, https://www.who.int/emergencies/diseases/novel-coronavirus-2019/interactive-timeline?gclid=Cj0KCQjwxJqHBhC4ARIsAChq4avP4ybyhepByx7gyCxS7h9encZvza5zMFyfeDcx-RsUXug5PLZNsOMaAIUPEALw_wcB#event-115 (2021, accessed October 6, 2021).
2. World Health Organization. WHO Coronavirus (COVID-19) Dashboard | WHO Coronavirus (COVID-19) Dashboard With Vaccination Data, <https://covid19.who.int/> (2021, accessed October 6, 2021).
3. World Health Organization. Coronavirus disease (COVID-19), <https://www.who.int/news-room/q-a-detail/coronavirus-disease-covid-19> (2021, accessed October 6, 2021).
4. Amnesty International. COVID-19: Health worker death toll rises to at least 17000 as organizations call for rapid vaccine rollout - Amnesty International, <https://www.amnesty.org/en/latest/press->

- release/2021/03/covid19-health-worker-death-toll-rises-to-at-least-17000-as-organizations-call-for-rapid-vaccine-rollout/ (2021, accessed October 6, 2021).
5. World Health Organization. *The impact of COVID-19 on health and care workers: a closer look at deaths*, <https://apps.who.int/iris/handle/10665/345300> (2021, accessed October 22, 2021).
 6. Mbachu CNP, Azubuiké CM-C, Mbachu II, et al. COVID-19 infection: Knowledge, attitude, practices, and impact among healthcare workers in a South-Eastern Nigerian state. *The Journal of Infection in Developing Countries* 2020; 14: 943–952.
 7. Gokdemir O, Pak H, Bakola M, et al. Family Physicians' Knowledge about and Attitudes towards COVID-19 - A Cross-sectional Multicentric Study. *Infection & Chemotherapy* 2020; 52: 539.
 8. Kramer V, Papazova I, Thoma A, et al. Subjective burden and perspectives of German healthcare workers during the COVID-19 pandemic. *European Archives of Psychiatry and Clinical Neuroscience* 2021; 271: 271–281.
 9. Wahed WYA, Hefzy EM, Ahmed MI, et al. Assessment of Knowledge, Attitudes, and Perception of Health Care Workers Regarding COVID-19, A Cross-Sectional Study from Egypt. *Journal of Community Health* 2020; 45: 1.
 10. Abou-Abbas L, Nasser Z, Fares Y, et al. Knowledge and practice of physicians during COVID-19 pandemic: a cross-sectional study in Lebanon. *BMC Public Health*; 20. Epub ahead of print 2020. DOI: 10.1186/s12889-020-09585-6.
 11. Amin F, Sharif S, Saeed R, et al. COVID-19 pandemic- knowledge, perception, anxiety and depression among frontline doctors of Pakistan. *BMC Psychiatry*; 20, <https://bmcp psychiatry.biomedcentral.com/track/pdf/10.1186/s12888-020-02864-x.pdf> (2020, accessed October 6, 2021).
 12. Hesarakı M, Akbarizadeh M, Ahmadidarrehsima S, et al. Knowledge, attitude, practice and clinical recommendations of health care workers towards COVID-19: a systematic review. *Reviews on Environmental Health* 2020; 36: 345–357.
 13. Limbu DK, Piryani RM, Id AKS. Healthcare workers' knowledge, attitude and practices during the COVID-19 pandemic response in a tertiary care hospital of Nepal. Epub ahead of print 2020. DOI: 10.1371/journal.pone.0242126.
 14. Qadah T. Knowledge and attitude among healthcare workers towards COVID-19: A cross sectional study from Jeddah city, Saudi Arabia. *Journal of Infection in Developing Countries* 2020; 14: 1090–1097.
 15. Roupa Z, Polychronis G, Latzourakis E, et al. Assessment of Knowledge and Perceptions of Health Workers Regarding COVID-19: A Cross-Sectional Study from Cyprus. *Journal of Community Health* 2021; 46: 1.
 16. Vatan A, Güçlü E, Öğütü A, et al. Knowledge and attitudes towards COVID-19 among emergency medical service workers. *Revista da Associação Médica Brasileira* 2020; 66: 1553–1559.
 17. Zhang M, Zhou M, Tang F, et al. Knowledge, attitude, and practice regarding COVID-19 among healthcare workers in Henan, China. *The Journal of Hospital Infection* 2020; 105: 183.

18. Assefa N, Soura A, Hemler EC, et al. COVID-19 Knowledge, Perception, Preventive Measures, Stigma, and Mental Health Among Healthcare Workers in Three Sub-Saharan African Countries: A Phone Survey. *The American Journal of Tropical Medicine and Hygiene* 2021; 105: 342.
19. Gebreselassie AF, Bekele A, Tatere HY, et al. Assessing the knowledge, attitude and perception on workplace readiness regarding COVID-19 among health care providers in Ethiopia - An internet-based survey. *PLoS ONE*; 16. Epub ahead of print March 1, 2021. DOI: 10.1371/journal.pone.0247848.
20. Unnikrishnan B, Rathi P, Shenoy SM, et al. Knowledge, Awareness and Perception of COVID-19 Pandemic Among Health Care Workers in a Tertiary Care Teaching Hospital in Coastal South India. *The Open Public Health Journal* 2021; 14: 135–139.
21. Arslanca T, Fidan C, Daggez M, et al. Knowledge, preventive behaviors and risk perception of the COVID-19 pandemic: A cross-sectional study in Turkish health care workers. *PLoS ONE*; 16. Epub ahead of print April 1, 2021. DOI: 10.1371/journal.pone.0250017.
22. Fadilah SZ, Kurniawati ND, Diyan P. A Systematic Review of Knowledge, Attitudes and Practices among Healthcare Workers on Personal Protective Equipment against Covid-19. *STRADA Jurnal Ilmiah Kesehatan* 2021; 10: 1213–1224.
23. Bhagavathula AS, Aldhaleei WA, Rahmani J, et al. Knowledge and Perceptions of COVID-19 Among Health Care Workers: Cross-Sectional Study. *JMIR Public Health Surveill* 2020;6(2):e19160 <https://publichealth.jmir.org/2020/2/e19160> 2020; 6: e19160.
24. Ciardi F, Menon V, Jensen JL, et al. Knowledge, attitudes and perceptions of covid-19 vaccination among healthcare workers of an inner-city hospital in New York. *Vaccines*; 9. Epub ahead of print May 1, 2021. DOI: 10.3390/vaccines9050516.
25. Guangul BA, Georgescu G, Osman M, et al. Healthcare workers attitude towards SARS-COVID-2 Vaccine, Ethiopia. *Global Journal of Infectious Diseases and Clinical Research* 2021; 7: 043–048.
26. Ross AGP, Crowe SM, Tyndall MW. Planning for the Next Global Pandemic. *International Journal of Infectious Diseases* 2015; 38: 89.
27. Dodds W. Chapter 4 Disease Now and Potential Future Pandemics. In: *The World's Worst Problems*, pp. 31–44.
28. Franchini M, Mannucci PM. Impact on human health of climate changes. *European Journal of Internal Medicine* 2015; 26: 1–5.
29. Khasnis AA, Nettleman MD. Global Warming and Infectious Disease. *Archives of Medical Research* 2005; 36: 689–696.
30. Raosoft Inc. Sample Size Calculator by Raosoft, Inc., <http://www.raosoft.com/samplesize.html> (accessed October 6, 2021).
31. Onwuegbuzie AJ, Collins KMT. The Role of Sampling in Mixed Methods-Research. *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie* 2017 69:2 2017; 69: 133–156.
32. Braun V, Clarke V. Using thematic analysis in psychology. *Qualitative Research in Psychology* 2006; 3: 77–101.

33. von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies. *International journal of surgery (London, England)* 2014; 12: 1495–1499.
34. The World Bank. World Bank Country and Lending Groups – World Bank Data Help Desk, <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups> (2021, accessed October 6, 2021).
35. Enenche Ejeh F, Saleh Saidu A, Owoicho S, et al. Knowledge, attitude, and practice among healthcare workers towards COVID-19 outbreak in Nigeria. *Epub ahead of print* 2017. DOI: 10.1016/j.heliyon.2020.e05557.
36. Kassie BA, Adane A, Kassahun EA, et al. Poor COVID-19 Preventive Practice among Healthcare Workers in Northwest Ethiopia, 2020. *Advances in Public Health*; 2020. *Epub ahead of print* 2020. DOI: 10.1155/2020/7526037.
37. Saqlain M, Munir MM, Rehman SU, et al. Knowledge, attitude, practice and perceived barriers among healthcare workers regarding COVID-19: a cross-sectional survey from Pakistan. *Journal of Hospital Infection* 2020; 105: 419–423.
38. Goddard AF, Patel M. The changing face of medical professionalism and the impact of COVID-19. *The Lancet* 2021; 397: 950–952.
39. Fouogue JT, Noubom M, Kenfack B, et al. Poor knowledge of COVID-19 and unfavourable perception of the response to the pandemic by healthcare workers at the Bafoussam Regional Hospital (West Region-Cameroon). *The Pan African Medical Journal*; 37. *Epub ahead of print* 2020. DOI: 10.11604/PAMJ.SUPP.2020.37.1.25688.
40. Dror AA, Eisenbach N, Taiber S, et al. Vaccine hesitancy: the next challenge in the fight against COVID-19. *European Journal of Epidemiology* 2020 35:8 2020; 35: 775–779.
41. Wouters OJ, Shadlen KC, Salcher-Konrad M, et al. Challenges in ensuring global access to COVID-19 vaccines: production, affordability, allocation, and deployment. *Lancet (London, England)* 2021; 397: 1023–1034.
42. Li Q, Guan X, Wu P, et al. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus–Infected Pneumonia. <https://doi.org/101056/NEJMoa2001316> 2020; 382: 1199–1207.
43. Mayer JD, Lewis ND. An inevitable pandemic: geographic insights into the COVID-19 global health emergency. <https://doi.org/101080/1538721620201786425> 2020; 61: 404–422.
44. Khosrawipour V, Lau H, Khosrawipour T, et al. Failure in initial stage containment of global COVID-19 epicenters. *Journal of medical virology* 2020; 92: 863–867.
45. Cabral S, Ito N, Pongeluppe L. The Disastrous Effects of Leaders in Denial: Evidence from the COVID-19 Crisis in Brazil. *SSRN Electronic Journal*. *Epub ahead of print* April 29, 2021. DOI: 10.2139/SSRN.3836147.
46. Yang K. What Can COVID-19 Tell Us About Evidence-Based Management?: <https://doi.org/101177/0275074020942406> 2020; 50: 706–712.

47. Raboisson D, Lhermie G. Living With COVID-19: A Systemic and Multi-Criteria Approach to Enact Evidence-Based Health Policy. *Frontiers in Public Health*; 8. Epub ahead of print June 16, 2020. DOI: 10.3389/fpubh.2020.00294.
48. Lancaster K, Rhodes T, Rosengarten M. Making evidence and policy in public health emergencies: Lessons from COVID-19 for adaptive evidence-making and intervention. *Evidence and Policy* 2020; 16: 477–490.
49. Liu P, Zhong X, Yu S. Striking a balance between science and politics: understanding the risk-based policy-making process during the outbreak of COVID-19 epidemic in China. <https://doi.org/101080/2381234620201745412> 2020; 5: 198–212.
50. Belcher P, Busse R, Figueras J, et al. *Quarterly of the European Observatory on Health Systems and Policies EUROHEALTH*. Brussels, <http://www.healthobservatory.eu><https://www.lse.ac.uk/lse-health> (2020).
51. Knobler S, Mahmoud A, Lemon S, et al. *Learning from SARS: Preparing for the Next Disease Outbreak*. Washington, DC: National Academies Press. Epub ahead of print April 26, 2004. DOI: 10.17226/10915.
52. Jaiswal J, LoSchiavo C, Perlman DC. Disinformation, Misinformation and Inequality-Driven Mistrust in the Time of COVID-19: Lessons Unlearned from AIDS Denialism. *AIDS and Behavior* 2020; 24: 1.
53. Baker DW. Trust in Health Care in the Time of COVID-19. *JAMA* 2020; 324: 2373–2375.
54. Dharawat A, Lourentzou I, Morales A, et al. Drink bleach or do what now? Covid-HeRA: A dataset for risk-informed health decision making in the presence of COVID19 misinformation, <https://arxiv.org/abs/2010.08743v1> (2020, accessed October 7, 2021).
55. Gallotti R, Valle F, Castaldo N, et al. Assessing the risks of “infodemics” in response to COVID-19 epidemics. *Nature human behaviour* 2020; 4: 1285–1293.
56. UNDP. Global Dashboard for Vaccine Equity - UNDP Covid-19 Data Futures Platform, <https://data.undp.org/vaccine-equity/> (2021, accessed October 10, 2021).
57. Norman J, Bar-Yam Y, Taleb N. *Systemic Risk of Pandemic via Novel Pathogens-Coronavirus: A Note*. New York, January 26, 2020.
58. Glasgow RE, Vinson C, Chambers D, et al. National Institutes of Health Approaches to Dissemination and Implementation Science: Current and Future Directions. *American Journal of Public Health* 2012; 102: 1274–1281.
59. Glasgow RE, Emmons KM. How can we increase translation of research into practice? Types of evidence needed. *Annual review of public health* 2007; 28: 413–433.

Figures

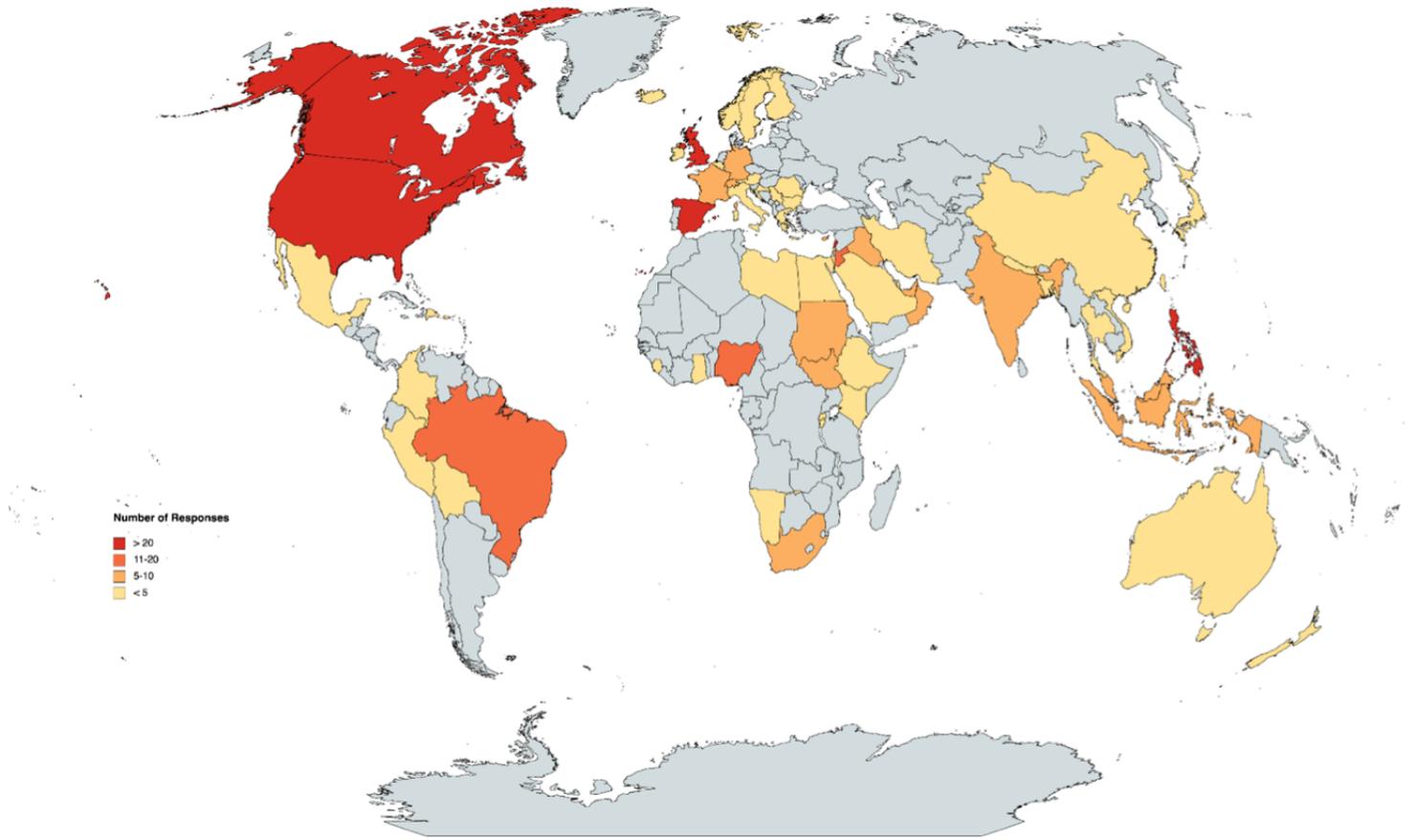


Figure 1

Visual representation of responses by country (n=399). This map depicts the countries from which responses were received. More than 20 responses were received from countries shaded in red (Canada, United States of America, Spain, United Kingdom, Lebanon, Philippines). The dark orange indicate that 11 to 20 physicians responded from that country, whereas the light orange shade indicates that 5 to 10 physicians from that country responded to the survey. Less than 5 responses were received from countries shaded in yellow. No responses were received from countries in grey.

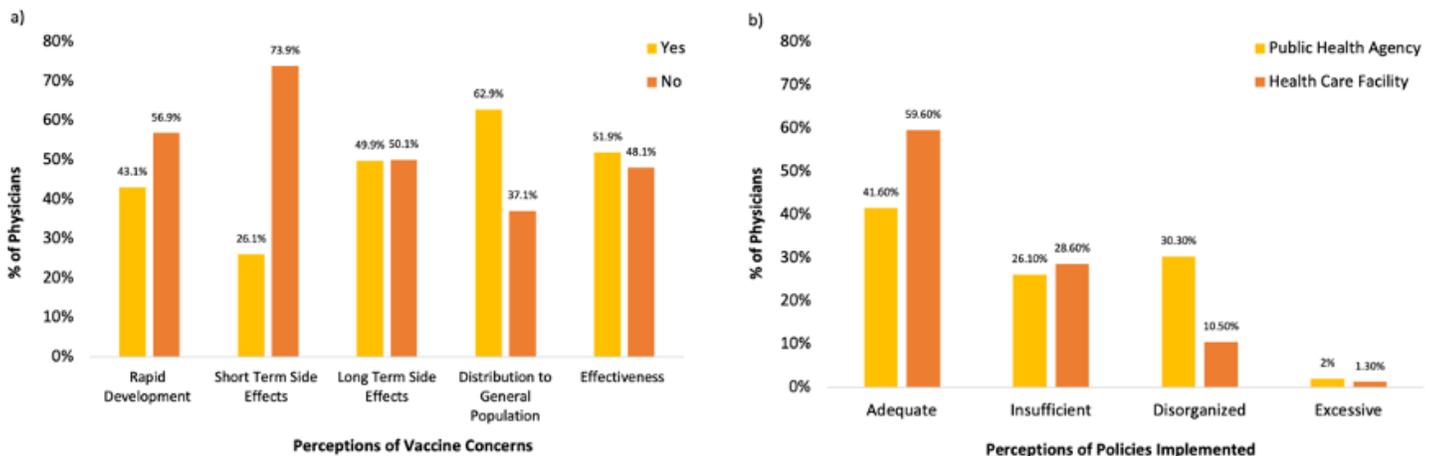


Figure 2

