

A Rapid Turnaround Survey of COVID-19 in LMICs: The Readiness, Responses, and Challenges of Healthcare Organizations

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SUMMARY

The purpose of this report is to better understand the initial readiness and response and the challenges of healthcare organizations in low- and middle-income countries (LMICs) during the COVID-19 pandemic. The University of Illinois at Chicago Center for Global Health developed and disseminated a rapid turnaround survey across its network of partners throughout 15 LMICs which included 40 healthcare organizations. The 29-item survey was based in part upon the World Health Organization's checklist for influenza pandemic preparedness and prior studies on the impact of disasters upon healthcare organizations and workers.

The survey identified a wide spectrum of readiness and response for COVID-19 among healthcare organizations. Overall, healthcare organizations reported facing the greatest difficulties in providing intensive medical care for COVID-19 given the lack of ICU beds (in 80%) and ventilators (in 75%). LMIC healthcare organizations were somewhat better able to prevent spread in healthcare organizations and to support the healthcare workforce, but also face major obstacles given that more than 70% lack personal protective equipment (PPE) and COVID-19 testing kits. 65% of the respondents showed confidence in hospital staff's knowledge about precautions to be taken to prevent COVID-19 infection among hospital personnel. Their ability to quarantine healthcare providers whenever needed was 70%. Healthcare organizations had limited confidence (60%) in the communities' ability to adopt handwashing and only 50% of healthcare organizations had confidence that their patients could practice social distancing. Analyses showed that the degree of readiness and response to the COVID-19 pandemic can be explained by the level of available economic and medical resources in their country.

Much needs to be done, both now as the outbreak spreads in LMICs and in the months and years after, to prepare for the next outbreak or pandemic. The international community needs to provide additional support for LMICs to control the pandemic including PPE, other medical supplies, drugs and equipment, healthcare facilities, and workforce training. Expenditures should be focused on building healthcare facilities' capacity for active surveillance, early detection, isolation, and contact tracing. Despite the obvious resource limitations, healthcare organizations in LMICs can do more to strengthen their capacities for isolating COVID-19 patients, for protecting older persons and other vulnerable groups, and for supporting healthcare workers. In the long run, a global effort is needed to strengthen public health infrastructure and disease control in all countries but especially in LMICs, both for COVID-19 and for other preventable communicable and non-communicable diseases.

BACKGROUND

The current COVID-19 pandemic has caused major strains on healthcare systems in terms of human and material resources, and these strains are expected to continue. A 2019 report from the World Health Organization (WHO) revealed significant gaps in most member states' influenza pandemic preparedness plans.¹ A recent study of COVID-19 among 138 countries demonstrated that only half of the countries had operational readiness at the highest levels, and a third had low levels of capacity, most of which were low- and middle-income countries (LMICs).² Understanding how best to advocate for and support healthcare organizations and the healthcare workforce in resource-poor nations is critically important for optimal response to the ongoing pandemic.

Prior epidemics have elucidated key strategies that should be applied now including early isolation methods, proper personal protective equipment (PPE), increased staffing, and public health measures to limit the spread of disease.³⁻⁵ Similarly, LMICs in sub-Saharan Africa may be able to draw upon public health infrastructure developed in response to the recent Ebola epidemic.⁶⁻⁸ Prior epidemics and pandemics have also shown the intense demands placed on the healthcare workforce. Particular demands include stigma associated with caring for those who are sick, risk of contamination to self and family members, concerns for personal safety, exposure to death and dying, and stress associated with undertaking new clinical roles.⁹⁻¹³ Healthcare workers in LMICs may be particularly vulnerable during this pandemic episode and may have difficulty accessing mental health and psychosocial support.^{14,15}

Challenges in community-based strategies to prevent outbreaks also exist and contribute to burdens on the healthcare system. Although social distancing is a well-established strategy to curb the spread of airborne infections,¹⁶ it is difficult to implement in many LMICs due to high population densities in many urban areas.¹⁷ Social distancing can also be costly to vulnerable populations, particularly those in economically fragile settings.¹⁸ Structural constraints, such as lack of access to preventative and acute healthcare, can also significantly hinder community members' abilities to follow public health recommendations.¹⁹

Understanding the challenges faced by healthcare organizations and communities, particularly in LMICs, is paramount to developing the best strategies for support and advocacy during this crisis. To improve understanding and to identify supportive actions, the University of Illinois at Chicago Center for Global Health (UIC CGH) and several of its global partners developed a rapid-turnaround survey to gather a contemporaneous snapshot of the current readiness, response, and challenges among healthcare organizations in LMICs.

METHODS

In brief, this was a rapid-turnaround survey of a purposive sample of 40 healthcare organizations in 15 LMICs focused on the readiness, responses, and challenges to healthcare organizations which was conducted near the beginning of the COVID-19 surge. Please see Appendix A for more details on survey development and data analysis.

FINDINGS

The UIC CGH received 40 surveys from healthcare organizations in 15 LMICs (Table 1). Of the 40 responding organizations, 33 (83%) were hospital facilities and 28 (70%) were publicly funded.

Table 1: Countries with Healthcare Organization Types

Healthcare Organization Type	Country
Hospitals	Cuba, Ethiopia, Ghana, India, Kosovo, Nepal, Nigeria, Pakistan, Senegal, Sierra Leone, Tajikistan, Turkey, Ukraine
Community health organizations	Bangladesh, India, Senegal
Ambulatory clinic	Bolivia

At the time of data collection, the number of COVID-19 cases in these countries ranged from 0 to 13,500 cases. Over the course of data collection, the rate of expansion of COVID-19 positive cases varied highly, with some countries experiencing more than a 600% increase from the time the survey opened until it closed.²⁰ Appendix B includes country-level indicators for each of the countries represented in the survey including percent increase in cases during the survey window.

Descending Order of Readiness and Response Items. All multiple choice survey items were clustered into three categories based on the overall percentage of healthcare organizations that were able to enact each measure (Table 2). This table demonstrates a spectrum of capacity from high (61-100%) to mid (31-60%) to low (0-30%) in the healthcare organizations' abilities to enact each measure. In particular, there was low capacity for items related to providing higher levels of care (e.g., available ventilators and ICU capacity).

Table 2: All Readiness and Response Items in Descending Order

High (61-100%)	Providing essential care (95%) Staff reporting as scheduled (93%) Triageing to prevent patient interaction (80%) Clear communication channels for healthcare workers (70%) Quarantining healthcare workers (70%) Adequate staffing (65%) Hotline for suspected COVID-19 patients (65%) Staff know precautions to prevent COVID-19 (65%) Staffing role changes (65%)
Mid (31-60%)	Handwashing in community (60%) Providing remote care (60%) Isolate COVID-19 positive patients (53%) Use outdoor screening locations (53%) Alternate care facilities (50%) Disaster response plan (50%) Social distancing in community (50%) Staff work past shifts (48%) Crisis counselors (45%)

Low (0-30%)	Testing patients for COVID-19 (30%) Sufficient PPE supply (28%) Ventilator capacity (25%) Testing staff for COVID-19 (23%) ICU capacity (20%)
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Grouping into Readiness and Response Variables. To further understand the high, mid, and low levels of uptake of survey items, a subset of the survey variables were grouped into three summary variables that corresponded to core themes explored in the survey. These three summary variables are: Preventing Spread in the Community (2 items); Preventing Spread in Healthcare Organizations (10 items); and Intensive Medical Care (2 items). A Total Score (14 items) based on the three summary variables was also created. Table 3 shows the individual survey items, the percentage of healthcare organizations enacting each measure; a score for the mean number of items each healthcare organization enacted; and the range of scores across all healthcare organizations. Healthcare organizations had the lowest scores in Intensive Medical Care, but also had relatively low scores in Preventing Spread in the Community, Preventing Spread in Healthcare Organizations, and Total Readiness and Response.

Table 3: Items Grouped into Readiness and Response Summary Variables

Preventing spread in the community (2 items)	Handwashing in community (60%) Social distancing in community (50%)
	<i>Mean score (range): 1.1 (0-2) of 2.0 (55%)</i>
Preventing spread in healthcare organization (10 items)	Triaging to prevent patient interaction (80%) Quarantining healthcare workers (70%) Staff know precautions to prevent COVID-19 (65%) Hotline for suspected COVID-19 patients (65%) Providing remote care (60%) Isolate COVID-19 positive patients (53%) Use outdoor screening locations (53%) Testing patients for COVID-19 (30%) Sufficient PPE supply (28%) Testing healthcare workers for COVID-19 (23%)
	<i>Mean score (range): 5.3 (1-9) of 10.0 (53%)</i>
Intensive Medical Care (2 items)	Ventilator Capacity (25%) ICU Capacity (20%)
	<i>Mean score (range): 0.5 (0-2) of 2.0 (25%)</i>
Total Readiness & Response (14 items)	<i>Mean score (range): 6.9 (1-13) of 14.0 (49%)</i>

Readiness and Responses Scores for Healthcare Organization's Countries.

To further examine the four readiness and responses variables, overall scores were created for each country (Table 4). For countries with multiple respondents, we provide the mean and range of scores for the individual healthcare organizations. Between one and nine healthcare organizations responded from each country. Note: the scores clearly do not represent the country as a whole or all of the country's healthcare organizations, but they may be a snapshot indicator of particular healthcare organization's readiness and response.

Table 4: Readiness and Response by Country

Country (n = responses per country)	Preventing Community Spread (2 Items)	Preventing Healthcare Organization Spread (10 Items)	Intensive Medical Care (2 Items)	Total Score (14 items)
Bangladesh (n=1)	2	4	0	6
Bolivia (n=1)	2	8	0	10
Cuba (n=1)	2	6	2	10
Ethiopia (n=8)	1 (0-2)	4 (1-6)	0 (0-1)	5 (3-9)
Ghana (n=5)	1 (0-2)	6 (3-7)	0 (0-2)	7 (3-10)
India (n=9)	1 (0-2)	6 (3-9)	1 (0-2)	7 (4-13)
Kosovo (n=2)	1 (0-1)	5 (4-6)	1 (0-1)	6 (5-7)
Nepal (n=1)	2	4	0	6
Nigeria (n=1)	2	5	0	7
Pakistan (n=2)	2 (2)	7 (6-8)	0 (0)	9 (8-10)
Senegal (n=4)	1 (0-2)	6 (4-7)	1 (0-2)	7 (6-11)
Sierra Leone (n=1)	0	8	0	8
Tajikistan (n=1)	0	2	0	2
Turkey (n=1)	1	9	1	11

Country (n = responses per country)	Preventing Community Spread (2 Items)	Preventing Healthcare Organization Spread (10 Items)	Intensive Medical Care (2 Items)	Total Score (14 items)
Ukraine (n=2)	2 (1-2)	5 (4-6)	1 (1)	8 (7-8)

N=40; results given as scores, with ranges provided in parentheses for countries with multiple respondents

Comparing LMICs by GDP Per Capita and Physician Density. To further examine the heterogeneity within LMICs, countries were divided into those with higher or lower economic activity (as measured by GDP per capita) and higher or lower physician density (as measured by the number of physicians per 1,000 people) (see Appendix A for details). Lower GDP country healthcare organizations had less ICU capacity, ventilator capacity, and staff knowing precautions to prevent the spread of COVID-19 (Table 5). Lower physician density country healthcare organizations had lower ventilator capacity, ICU capacity, PPE, strategic plans for disaster response, and staff knowing precautions to prevent the spread of COVID-19 (Table 6).

Table 5: Comparing Healthcare Organizations by Lower and Higher GDP Per Capita (significant and borderline findings only)

Variable	Lower GDP per Capita	Higher GDP per Capita	Chi-Square
ICU Capacity	1/18 (6%)	7/22 (32%)	$p < .039^*$
Staff Know Precautions	9/18 (50%)	17/22(77%)	$p < .072^{**}$
Ventilator Capacity	2/18 (11%)	8/22 (36%)	$p < .067^{**}$

*statistical significance

**borderline significance

Table 6: Comparing Healthcare Organizations by Lower and Higher Availability of Physicians per 1000 Persons (significant and borderline findings only)

Variable	Lower Physicians per 1000	Higher Physicians per 1000	Chi-Square
PPE	2/21 (10%)	9/19 (47%)	$p < .007^*$
Strategic Plan	7/21 (33%)	13/19 (68%)	$p < .027^*$
Ventilator Capacity	3/21 (14%)	7/19 (37%)	$p < .100^{**}$
ICU Capacity	2/21 (10%)	6/19 (32%)	$p < .082^{**}$
Staff Know Precautions	11/21 (52%)	15/19 (79%)	$p < .079^{**}$

*statistical significance

**borderline significance

T-tests were conducted comparing the differences in means for each of the four summary readiness and responses variables, the country GDP per capita (Table 7) and physicians per 1,000 people (Table 8). Healthcare organizations in lower GDP countries had lower scores for Intensive Medical Care, Preventing Spread in Healthcare Organizations, and Total Readiness and Responses. Healthcare organizations in lower physician density countries had lower scores for Intensive Medical Care and Total Readiness and Responses.

Table 7: Comparing Healthcare Organizations by Lower and Higher GDP Per Capita

Variable	Lower GDP per Capita	Higher GDP per Capita	T-test
Preventing Spread in the Community	1.1 (SD=.9)	1.1 (SD=.9)	NS
Preventing Spread in Healthcare Organizations	4.6 (SD=2.1)	5.8 (SD=1.8)	p<.073**
Intensive Medical Care	0.2 (SD=.5)	0.7 (SD=.8)	p<.029*
Total Score	5.9 (SD=2.6)	7.6 (SD=2.4)	p<.047*

*statistical significance

**borderline significance

Table 8: Comparing Healthcare Organizations by Lower and Higher Availability of Physicians per 1000 Persons

Variable	Lower Physicians per 1000	Higher Physicians per 1000	T-test
Preventing Spread in the Community	1.1 (SD=.9)	1.1 (SD=.9)	NS
Preventing Spread in Healthcare Organizations	4.8 (SD=1.9)	5.7 (SD=2.1)	NS
Intensive Medical Care	0.2 (SD=.6)	0.7 (SD=.8)	p<.044*
Total Score	6.1 (SD=2.4)	7.6 (SD=2.8)	p<.090**

*statistical significance

**borderline significance

QUALITATIVE ANALYSIS

The qualitative analysis was based upon narrative responses from 60% of survey respondents to the following open-ended item: "Please add some additional thoughts related to COVID-19 in your healthcare organization." The analysis identified several common themes related to COVID-19 either healthcare organization or communities (Table 9). The healthcare organizations were preparing for a surge in COVID-19 patients and expressed concerns about not having adequate resources. Insufficient ICU capacity and equipment, insufficient PPE, and limited testing kit availability as well as limited space for isolating patients were of utmost

importance to respondents. Regarding communities, respondents reported challenges in community-based prevention strategies such as social distancing and hand hygiene due to communication issues and the inability of vulnerable populations to follow recommended strategies.

Table 9: Challenges faced by healthcare system and communities, qualitative responses

Construct	Explanation	Exemplary Quotes
Healthcare Organization Considerations		
Critical care capacity	Respondents were concerned about insufficient medical resources especially ventilators, ICUs, and medications.	“One of the main concerns is the lack of intensive care units and ventilators in our city, the number of beds available is approximately 9, insufficient quantity for a population of 2 million inhabitants. Another concern is the lack of medications that can be used for COVID-19 Cases.” (Bolivia)
Disaster preparedness	Some respondents had a disaster plan in place including cancelling elective procedures, prioritizing and repurposing resources in anticipation of a surge of patients, and other planning.	<p>“My hospital is planned to treat COVID patients as a second step inside our health system, not at this time, when the numbers of cases increase to many more, in that setting the whole hospital can be turn into a big ICU if necessary, the technology, supplies and health workers are getting prepare for that situation.” (Cuba)</p> <p>“We do have poor experience in disaster management (No PPE, staff screening, budget, continuing training, et and lack of emergency medical supply, MV, trained personnel in emergency medicine” (Ethiopia)</p>
Preventing spread in healthcare organizations	Screening of healthcare workers was low, but most respondents had some measures for minimizing potential COVID-19 exposures for healthcare workers including use of quarantine and educating healthcare workers on precautions to avoid exposures.	<p>“CoD19 will cause crisis to community and health worker at same level.” (Ethiopia)</p> <p>“The main challenge we are focusing is the protection of medical and paramedical staff accruing this viral infection.” (Pakistan)</p>
Staff protection, including providing PPE and addressing mental health concerns	Healthcare workers report insufficient supply of PPE and resultant stigma of healthcare workers due to community fear of contagion. Mental health support for healthcare workers are in place for only about half of respondents.	<p>“Fear of healthcare givers, [because] not supplied with PPE, and the stigmata from the society on healthcare gives, society think as if corona will spread from hospital [rather] than source from the society.” (Ethiopia)</p> <p>“We note an insufficiency in the involvement of nurses in decision making and to show a recognition of their action in the care of the patients. Also, front-line nurses lack protective equipment and do not have a representative at the Ministry of Health level.” (Senegal)</p>

Construct	Explanation	Exemplary Quotes
Challenges in testing healthcare workers and patients	Limited supplies of testing kits and healthcare accessibility contribute to challenges in identifying COVID-19 cases.	<p>“testing...of COVID19 patients is restricted to designated laboratories.” (India)</p> <p>“We can’t test all.” (Ukraine)</p>
Community Considerations		
Challenges in communication and uptake of community-based prevention strategies	Communities face challenges involving the spread of misinformation and miscommunications from official sources, contributing to difficulty in adhering to recommended prevention strategies such as self-isolation and social distancing.	<p>“I think the main problem is that citizens know how to take precautions to protect their and our [physicians’] health and safety against COVID-19 but they don’t do this. Some of them [are] still not using masks, they think that they don’t have symptoms and they don’t need it.” (Ukraine)</p> <p>“Communication to communities concerning risk events and misinformation [is] poorly done.” (Ghana)</p>
Social Distancing and Hand Hygiene	Communities face challenges in adhering to social distancing guidelines due to crowded housing, dependence on hourly wages, as well as decreased access to sanitary water for hand-washing.	<p>“We need to ensure safety of the most vulnerable (economically weaker sections) who don’t have access to maintaining social distancing or practicing hand hygiene and are also the ones mostly affected by lockdowns and economic fallouts.” (India).</p>

CONCLUSIONS

This rapid turnaround survey of a purposive sample of 40 healthcare organizations in 15 LMICs identified their readiness and responses to the COVID-19 pandemic at the time when the surge was beginning in their countries.

The survey identified a wide spectrum of readiness and responses for COVID-19 among healthcare organizations. Overall, healthcare organizations reported facing the greatest difficulties in providing intensive medical care for COVID-19 patients given the lack of ICU beds (in 80%) and ventilators (in 75%).

LMIC healthcare organizations were somewhat better able to prevent spread in healthcare organizations and to support the healthcare workforce. However they also face major obstacles given that more than 70% lack personal protective equipment (PPE) and COVID-19 testing kits.

Sixty-five percent of respondents showed confidence in hospital staff’s knowledge about precautions to be taken to prevent COVID-19 infection among hospital personnel. This is despite the fact that since 2005 WHO has promoted a strong and effective campaign to promote hand hygiene and other infection prevention measures in health facilities.^{21,22} In the past year, WHO called upon its member countries to strongly promote hand hygiene among health workers.²³

The role of protecting the healthcare workforce at the forefront of the COVID-19 response cannot be overemphasized. Yet, in resource poor LMIC healthcare facilities, staff shortages relative to high patient volumes is a major challenge. Their ability to quarantine healthcare providers whenever needed was 70%. Augmenting the stress for healthcare providers, family and community members fear infection from the healthcare workers which further stigmatizes and isolates those already exhausted and traumatized from their work.

Healthcare organizations had limited confidence (60%) in their communities' ability to adopt handwashing as an easy and effective method for protection despite several decades of awareness about the causal link between hand hygiene and infection.²⁴

Only 50% of healthcare organizations had confidence that their patients could practice social distancing. Social distancing is difficult to implement in many LMICs due to high population densities in many urban areas and many living in large multi-generational households.^{17,25} Vulnerable populations are also susceptible to adverse economic effects from social distancing.¹⁷

The findings also examined the relationship between COVID-19 readiness and response and socio-economic determinants. Analyses showed that the healthcare organization's readiness and response to the COVID-19 pandemic can be explained statistically by the level of available economic and medical resources in their country.

This means pandemic response, or inadequate responses and resultant deaths, is to a very significant degree caused by failures to invest in and build adequate public health and healthcare systems by national governments and by international donors and agencies. Yet it is healthcare workers on the frontline who often feel the most helpless and blamed.

RECOMMENDATIONS

Much more work is required, both now as the COVID-19 outbreak spreads in LMICs and in the months and years after, to prepare for the next disease outbreak or pandemic.

The results also indicate that despite the obvious resource limitations, healthcare organizations in LMICs can do more to strengthen their capacities for isolating COVID-19 patients, for protecting older persons and other vulnerable groups, and for supporting healthcare workers.

The international community needs to provide additional support for LMICs to control the pandemic including PPE, other medical supplies, drugs and equipment, healthcare facilities, and workforce training. Expenditures should be focused on building the healthcare organizations' capacities for active surveillance, early detection, isolation, and contact tracing.²⁶

In the long run, a global effort is needed to strengthen public health infrastructure and disease control in all countries but especially in LMICs, both for COVID-19 and for other preventable communicable and non-communicable diseases. Given the interconnectivity of the world's countries, we should assume that viral transmission between countries is a certainty. Supporting healthcare organizations and public health systems in LMICs is an essential element for all of our long-term survival and prosperity.

The following specific recommendations include those suggested by healthcare workers from the 15 LMICs participating in the survey.

For Healthcare Organizations.

- Provide training for healthcare workers on infection prevention and control practices and clinical management of patients with COVID-19.
- Provide additional support for the healthcare workforce including PPE, training on safety precautions, physical relief (e.g., rest, access to meals and water while working, housing for healthcare workers with long commutes), and mental health resources and psychosocial services.
- Provide timely evaluation from occupational health services in the event healthcare workers are exposed or become symptomatic and teach healthcare workers how to minimize risks of transmission to household members.
- Strengthen procedures for isolating COVID-19 patients from others, including minimizing unnecessary exposures to the healthcare system, early screening and identification of suspected cases to allow for isolation, and establishment of isolation zones.
- Avoid pay cuts or delayed payment of salaries to healthcare workers.
- Establish and enforce workmen's compensation or hazard pay for healthcare workers which could improve their willingness and motivation to work in the pandemic.

For Communities.

- Develop and implement modified strategies for social distancing, handwashing, and isolation for those over 60 and those with immunosuppression and co-morbidities should they fall seriously ill.
- Improve media messaging to disseminate information broadly in countries whose households have access to television or radio, a strategy that has been effective in other public health campaigns, despite potential miscommunications due to lack of personal messaging, face-to-face interaction, or stigma associated with the topic.²⁷
- Consider age, family values, and key cultural specificities in behavioral change campaigns and information education and communication messages, including the incorporation of religious leaders and traditional healers.
- Implement additional public health measures such as provision of community basic protective equipment, community cohorting for suspected infections, and increasing access to clean water and hand hygiene stations.

For LMICs.

- Ensure healthcare resources are equitably distributed within LMICs to provide fair access to all populations, including the most vulnerable populations.
- Enable diverse and equitable representation of medical healthcare workers in ministries of health which is needed to ensure policies best reflect the needs of the healthcare workers during a pandemic.
- Ensure that communication about the pandemic is accurate, timely, and transparent.
- Establish point-of-care testing which requires fewer human and technical resources and allows for better utilization and allocation of critical care resources.
- Build affordable, people-centered, and efficient health systems that satisfy the priority health needs of the population.
- Address the social determinants of health through improvements in education, housing facilities, water supply systems, and poverty reduction.
- Create an enabling environment in LMICs for local private sector innovative investment of low-cost technology to manufacture PPE and other health supplies.
- Implement and/or strengthen pandemic preparedness and response plans and public health systems in accordance with WHO guidelines.
- Strengthen the legal environment for epidemic investigation and response.

- Create systems to coordinate international support and establish transparent and accountable systems.
- Encourage universities and other training institutions to incorporate infection prevention practices and outbreak preparedness into their learning curriculum.
- Maintain high alert post-lockdown and make critical investments in strengthening surveillance and rapid response so as to prevent and/or manage further outbreaks.
- Provide support for research and clinical evaluation on outbreak preparedness and infection prevention and control practices.

For the International Community.

- Donate funds that will be used for smart investments to strengthen public health infrastructure and disease control for COVID-19 and other preventable communicable and non-communicable diseases so as to make up for the inequities in health expenditures in LMICs.
- Address the heterogeneous distribution of healthcare resources among, between, and within LMICs which accounts for disparities and higher vulnerability to pandemic deaths.
- Provide support to LMICs focused on improving their capacity for intensive medical treatment of COVID-19 as well as supportive and palliative care.
- Support LMICs to create resilient health systems that are able to respond adequately to emerging global health security threats.
- Level the playing field between HICs and LMICs in terms of competing for necessary COVID-19 resources, especially PPE and COVID-19 testing kits, and do not support policies that block the export of critical medical resources to LMICs.
- Strengthen the implementation of WHO's 2007 International Health Regulations.²⁸
- Support the WHO and other UN agencies' funds for COVID-19 relief and strengthen and coordinate donor country contributions and efforts as a developmental priority.

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Appendix A: Methods

The survey instrument was based upon a review of the WHO pandemic checklist²⁹ and prior studies on the impact of disasters on healthcare workers and organizations.^{4,5,30} Survey development was an iterative process between UIC CGH and its global health network partners. The final version of the survey consisted of 29 items including one open-ended question where respondents were asked to provide additional thoughts related to COVID-19 in their healthcare organizations.

Secondary data on country-level demographic, economic, travel, and health security indicators were collected for all countries where a survey was completed (see Appendix B for full list). Country-level indicators included scores from the Global Health Security Index (GHSI),³¹ a comprehensive assessment of global health security capabilities in 195 countries.

The survey was distributed online via Qualtrics from March 27 to April 8, 2020 to a purposively selected sample of healthcare organizations across 15 LMIC countries that were members of the UIC CGH's global health network and were directly or indirectly involved in the COVID-19 response in their respective countries. For analysis, only one response per healthcare organization was included, but multiple responses per country were allowed.

For purposes of analysis, four summary variables were created. These included three variables based on items in the survey to summarize each the readiness and responses of healthcare organizations to address COVID-19 (described in the section "Grouping into Readiness and Response Variables" and Table 3). These three variables were: Preventing Spread in the Community (2 items); Preventing Spread within Healthcare Organizations (10 items); and Intensive Medical Care (2 items). Those scores were then summed to create a Total Readiness and Responses variable. These were calculated at both the organization- and country-level.

The quantitative analysis was performed using SPSS V25. Descriptive and univariate statistics were calculated.

Dichotomous variables were created for GDP per Capita in US dollars (High GDP per capita \geq 2000; Low GDP per Capita $<$ 2000) and Physicians per 1,000 People (High Physicians per 1000 People $>$ 0.7; Low Physicians per 1000 People \leq 0.7). Chi-squared and t-tests were used to measure each of those against 11 readiness and responses indicators.

Sixty percent of respondents included several-sentence comments when asked to respond to the question, "Please add some additional thoughts related to COVID-19 in your healthcare organization." The qualitative analysis employed an inductive thematic analysis to identify common themes across the written survey responses as per the guidelines outlined by Braun and Clarke.³² First, each response was read and emerging patterns were coded and grouped into prospective themes. The responses were categorized as considerations in the healthcare system or considerations for communities. Next, themes were identified and analyzed within those codes: 1) critical care capacity, 2) disaster preparedness, 3) prevention of spread of disease in healthcare organizations, 4) case identification, 5) protection of healthcare workers, and 6) prevention of community spread.

Appendix B: Country Key Indicators

Country	Pop. in millions ¹	GDP per capita in US dollars ²	GHSI overall score ³	Airplane passengers traveling into country in millions ⁴	Physicians per 1000 people ⁵	Healthcare expenditure as % of GDP ⁶	Total cases (deaths) 3/27/20 ⁷	Total cases (deaths) 4/8/20 ⁷	% Increase in cases between survey opening and closing
Bangladesh	161.36	1698	35.0	5.98	0.53	2.27	48 (5)	164 (17)	242%
Bolivia	11.35	3548	35.8	4.12	1.61	6.44	39 (0)	194 (14)	397%
Cuba	11.34	8822	35.2	0.56	8.19	11.71	67 (1)	396 (11)	491%
Ethiopia	109.22	772	40.6	11.50	0.10	3.50	12 (0)	52 (1)	333%
Ghana	29.77	2202	35.5	0.47	0.18	3.26	132 (3)	287 (5)	117%
India	1353.00	2010	46.5	164.04	0.78	3.54	724 (17)	5194 (149)	617%
Kosovo	1.85	4302	No data	2.37	2.30	No data	79 (1)	184 (5)	133%
Nepal	28.09	1034	35.1	3.30	0.65	5.55	3 (0)	9 (0)	200%
Nigeria	195.87	2028	37.8	8.17	0.38	3.76	65 (1)	254 (6)	291%
Pakistan	212.22	1482	35.5	6.88	0.98	2.90	1057 (8)	4072 (58)	285%
Senegal	15.85	1522	37.9	0.02	0.07	4.13	105 (0)	237 (2)	125%
Sierra Leone	7.65	534	38.2	0.05	0.03	13.42	0 (0)	6 (0)	-
Tajikistan	9.10	827	32.3	0.49	1.70	7.23	0 (0)	0 (0)	0%
Turkey	82.32	9370	52.4	115.56	1.76	4.22	1196 (16)	3892 (76)	225%
Ukraine	44.62	3095	38	7.85	3.01	7.00	62 (1)	208 (7)	235%

¹ World Bank: <https://data.worldbank.org/indicator/sp.pop.totl>

² World Bank: <https://data.worldbank.org/indicator/NY.GDP.PCAP.CD>

³ Global Health Security Index: <https://www.ghsindex.org/>

⁴ World Bank: <https://data.worldbank.org/indicator/is.air.psgg>

⁵ World Bank: <https://data.worldbank.org/indicator/sh.med.phys.zs>

⁶ World Bank: <https://data.worldbank.org/indicator/SH.XPD.CHEX.GD.ZS>

⁷ WHO COVID-19 Dashboard <https://covid19.who.int/>