A national survey of hospital readiness during the COVID-19 pandemic in Nigeria

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Abstract

Introduction

The COVID-19 pandemic continues to overwhelm health systems across the globe. We aimed to assess the readiness of hospitals in Nigeria to respond to the COVID-19 outbreak.

Method

Between April and October 2020, hospital representatives completed a modified World Health Organisation (WHO) COVID-19 hospital readiness checklist consisting of 13 components and 124 indicators. Readiness scores were classified as adequate (score ≥80%), moderate (score 50–79.9%) and not ready (score <50%).
Results

Among 20 (17 tertiary and three secondary) hospitals from all six geopolitical zones of Nigeria, readiness score ranged from 28.2% to 88.7% (median 68.4%), and only three (15%) hospitals had adequate readiness. There was a median of 15 isolation beds, four ICU beds and four ventilators per hospital, but over 45% of hospitals established isolation facilities and procured ventilators after the onset of COVID-19. Of the 13 readiness components, the lowest readiness scores were reported for surge capacity (61.1%), human resources (59.1%), staff welfare (50%) and availability of critical items (47.7%).

Conclusion

Most hospitals in Nigeria were not adequately prepared to respond to the COVID-19 outbreak. Current efforts to strengthen hospital preparedness should prioritize challenges related to surge capacity, critical care for COVID-19 patients, and staff welfare and protection.

Introduction

The coronavirus disease 2019 (COVID-19) pandemic is currently ravaging countries across the world, including Nigeria [1]. The World Health Organisation (WHO) had earlier categorised Nigeria as a high-risk country for the spread of the disease in view of its weak healthcare system, large population, and sizeable travelling population across various international destinations [2, 3].

The first case of COVID-19 in Nigeria was reported on the 27th of February 2020 [4]. As of 25th April 2021, Nigeria has reported 164,684 confirmed cases and 2,061 deaths due to COVID-19 [5]. During the first few months of the COVID-19 pandemic in Nigeria, there were disruptions in health service delivery across the country, limited availability of isolation facilities and apparent inadequate preparedness of hospitals to respond to the outbreak. The public health response to the COVID-19 in Nigeria [6], and some aspects of public health preparedness towards COVID-19 outbreak in Nigeria have been previously described [7, 8]. However, none of these studies directly accessed the readiness of hospitals to respond the COVID-19 pandemic on a national scale. Inadequate readiness of hospitals to respond to the COVID-19 pandemic may lead to inadvertent exposure of healthcare workers, poor outcomes among hospitalised patients and disrupt routine delivery of essential health services [3, 9, 10].

In this study, we determined the level of readiness of hospitals in Nigeria to respond to the COVID-19 pandemic. The outcome of this assessment will provide knowledge to guide interventions to improve preparedness for the sustained pandemic response and determine areas of priority for intervention in the country.

Methods

Study design

A descriptive cross-sectional study was conducted among public healthcare facilities in Nigeria. Beginning in April 2020, we invited secondary and tertiary healthcare facilities designated as COVID-19 treatment centres across all six geopolitical zones of the country to participate in the study. At the time of the study, the 36 states and the Federal Capital Territory (FCT) of Nigeria had a total of 68 designated public funded hospital-based COVID-19 treatment centre located within secondary or tertiary health facilities, with at least one treatment centres per
state. We invited all 68 public hospitals to participate in this study by contacting the head of treatment centre in each hospital. Participating hospitals were selected by purposive sampling, based on their willingness to participate.

Data collection
A total of 20 of the 68 treatment centres agreed to participate in the study. Information on hospital characteristics, such as availability of beds, isolation units, intensive care units (ICU), ventilators, and specialist COVID-19-related health workforce, were obtained using a structured questionnaire. Data on hospital readiness was obtained using a modified WHO COVID-19 hospital readiness checklist (interim version February 2020). The WHO readiness checklist was developed to guide hospitals to define and initiate priority actions needed to ensure a rapid response to the COVID-19 outbreak. This original checklist consisted of 11 key components; under each component, there is a list of questions (or indicators) regarding the status of implementation of the recommended action specific to that component. We modified the checklist by adding two more components: staff welfare and availability of critical items (S1 Text). These are also essential aspects of hospital preparedness as identified by the WHO [5, 7–9]. The indicators for the 11 components were rephrased for clarity and questions for the last two components were developed after reviewing published recommendations from the WHO [5, 7–9]. Overall, the modified checklist had 13 components and 124 indicators. The study checklist and questionnaire was pre-tested in one of the COVID-19 treatment center and this health facility was excluded from participating in the survey.

Hard copies of the questionnaire and checklist were printed out from soft copies send to each participating hospital and completed by one or more representatives of the hospital (i.e., Medical Director, or Head of Clinical Services or Head of COVID-19 response team, etc.) who had necessary information about service delivery in the hospital and preparations toward the COVID-19 pandemic.

Scoring
Responses to each indicator on the checklist were classified into four groups: not started, due for review, in progress and completed (NB. the responses in the original checklist did not include "not started"). A response of “completed” was scored 2, “in progress” and “due for review” were scored 1 each, and “not started” was scored 0. The scores for each component and the overall score were used to calculate percentage readiness scores.

The readiness scores were classified as adequate (≥80%), moderate (50–79%) and limited/not ready (<50%), using previously established WHO scoring classification [10].

Data analysis
Data from each centre were entered, cleaned, aggregated, and analysed using Microsoft Excel software. Research teams in each hospital ensured that all responses in the checklist and questionnaire were answered before data entry to avoid missing data. Descriptive statistics were computed for continuous variables and presented using median (range) while frequencies and proportions were generated for categorical variables. Results were presented using tables and chart.

Ethics approval and consent to participate
Ethical approval for the study was obtained from the National Health Research and Ethics Committee. (NHREC/01/01/2007-14/04/2020). Individual informed consent was not required
because only one individual completed the questionnaire for each institution (hospital) and the hospital had given consent for the questionnaire to be completed. The Informed Consent procedure for our research was approved by National Health Research and Ethics Committee Nigeria (NHREC/01/01/2007-14/04/2020).

Results

Characteristics of participating hospitals

The characteristics of participating hospitals are summarised in Table 1. A total of 20 hospitals across all six geopolitical zones of the country, comprising 17 tertiary health facilities and three secondary health facilities, participated in the study. All hospitals were designated as isolation/COVID-19 treatment centres by Federal and State health authorities. Of the 20 hospitals 13 (65%) were Federal hospitals while seven (35%) hospitals were managed by State governments. The hospitals had a total bed capacity of 8746 beds, with a median (range) of 388 beds (150–800 beds). As of the time of evaluation, 18 hospitals had admitted a suspected or confirmed case of COVID-19.

COVID-19-related infrastructure and equipment

Most of the hospitals (18 of 20) had designated isolation units, but nine (45%) of these hospitals established isolation units after the onset of the COVID-19 outbreak in Nigeria. Sixteen hospitals had functional (ICU), with a median of four ICU beds per hospital. Seventeen hospitals had functional ventilators for all types of patient care, with a total of 96 ventilators, and a median of four ventilators per hospital. Fifty-four (56.3%) of the ventilators were procured for COVID-19 response.

COVID-19-related specialist human resources

The total number of full-time specialist human resource for COVID-19 response ranged from 20 for infectious diseases (ID) physicians to 111 for public health physicians (Table 1). Majority of hospitals (17 of 20) had at least one anaesthesiologist on full term employment, while only 11 hospitals had ID physicians on full term employment. About 90% of ID physicians had been trained on COVID-19 intervention, while about 53.2% of public health physicians and 28.8% of anaesthesiologists had prior training for COVID-19 intervention.

Hospital readiness scores

The compliance of the 20 hospitals with the modified WHO hospital readiness checklist for COVID-19 response is summarised in Table 2. The readiness scores ranged from 28.2% to 88.7%. Three (15%) hospitals had ‘adequate’ readiness, 15 (75%) had ‘moderate’ readiness and two (10%) hospitals were classified as ‘not ready’. Of the three secondary health facilities studied, one had ‘adequate’ readiness score, one was ‘moderately ready’ and the third was ‘not ready’. Of the three hospitals with ‘adequate’ readiness, two were evaluated before June 2020, while one was evaluated after June 2020.

Components of hospital readiness for COVID 19

The overall readiness scores according to the various components of the readiness checklist ranged from 47.7% to 85% (Fig 1). Infection prevention and control (85%) and surveillance (80.6%) had the highest readiness scores, while staff welfare (50%) and availability of critical items (47.7%) had the lowest readiness scores. The following section outlines the level of implementation of indicators in each component of the readiness checklist.
Table 1. COVID-19 hospital readiness in Nigeria: Characteristics of hospital surveyed.

| Characteristics                                      | N = 20 hospitals n (%) | Median | Range | Total |
|------------------------------------------------------|------------------------|--------|-------|-------|
| **Administrative status**                            |                        |        |       |       |
| Federal                                              | 13 (65)                |        |       |       |
| State                                                | 7 (35)                 |        |       |       |
| **Level of care**                                    |                        |        |       |       |
| Secondary                                            | 3 (15)                 |        |       |       |
| Tertiary                                             | 17 (85)                |        |       |       |
| **Features in respect of care of COVID-19**          |                        |        |       |       |
| Hospital has admitted suspected or confirmed cases   | 18 (90)                |        |       |       |
| Hospital with functional IPC Committee               | 14 (70)                |        |       |       |
| Hospitals established Isolation unit on account of COVID-19 | 9 (45)             |        |       |       |
| Beds in hospital                                     | 20 (100.0)             | 388    | 150–800 | 8746  |
| Beds in isolation units                              | 18 (90)                | 15.0   | 2–94 | 381   |
| Beds in Adult Isolation units                        | 18 (90)                | 13.0   | 2–94 | 360   |
| Beds in Paediatric Isolation units                   | 4 (20)                 | 3.0    | 2–9  | 21    |
| Beds in a single room                                | 12 (60)                | 2.0    | 1–8  | 34    |
| Beds in ICU                                          | 16 (80)                | 4      | 3–12 | 95    |
| Beds in Adult ICU                                    | 16 (80)                | 5      | 3–8  | 74    |
| Beds in paediatric ICU                               | 4 (20)                 | 3      | 1–4  | 11    |
| Functional Ventilators                               | 17 (85)                | 4      | 1–14 | 96    |
| Ventilators procured due to COVID-19                 | 13 (65)                | 1      | 1–11 | 54    |
| **Human resource for COVID-19 response**            |                        |        |       |       |
| **Anaesthesiologists**                               |                        |        |       |       |
| Full term                                            | 17 (85)                | 4      | 1–14 | 80    |
| Trained for COVID 19 intervention                    | 8 (40)                 | 2      | 1–6  | 23    |
| **Infectious disease physicians**                    |                        |        |       |       |
| Full term                                            | 11 (55)                | 1      | 1–5  | 20    |
| Trained for COVID 19 intervention                    | 10 (50)                | 1      | 1–4  | 18    |
| **Public health physicians**                         |                        |        |       |       |
| Full term                                            | 16 (80)                | 7      | 1–28 | 111   |
| Trained for COVID 19 intervention                    | 10 (50)                | 2      | 1–7  | 39    |
| **Pulmonologists**                                   |                        |        |       |       |
| Full term                                            | 15 (75)                | 1      | 1–3  | 20    |
| Trained for COVID 19 intervention                    | 10 (50)                | 1      | 1–2  | 14    |
| **Clinical microbiologists**                         |                        |        |       |       |
| Full term                                            | 13 (65)                | 1      | 1–7  | 37    |
| Trained for COVID 19 intervention                    | 9 (45)                 | 1      | 1–5  | 16    |
| **Infection control officer**                        |                        |        |       |       |
| Full term                                            | 16 (80)                | 2      | 1–6  | 47    |
| Trained for COVID 19 intervention                    | 13 (65)                | 2      | 1–5  | 38    |

Key: N-number of study participants, ICU-intensive care unit, IPC-infection prevention and control

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Incident management team and surge capacity

Only 14 (70%) of the 20 hospitals evaluated had established an incident management committee, and 40% and 35% had an emergency response plan and an emergency operation centre, respectively (Table 3).
Regarding surge capacity, most hospitals (80%) had cancelled nonessential services, but less than half of the hospitals have estimated their capacity to accommodate COVID-19 cases and identified ways of expanding hospital in-patient capacity. Only seven (35%) hospitals had developed strategies to address challenges associated with critical care (Table 3).

Infection prevention and control (IPC)

Most hospitals had completed indicators related to IPC, including training of healthcare workers (HCW) on IPC (75%), provision of IPC resources (80%) and compliance with isolation (80%), and droplet/contact precautions (80%) by HCW (Table 4). Most hospitals (80%) also have a team of HCW designated to care exclusively for suspected and confirmed cases of COVID 19. However, only 50% of hospitals had certified that HCW are applying standard

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Table 2. Compliance with 13 components of modified WHO COVID-19 readiness checklist among 20 hospitals in Nigeria.

| Name of Hospital | Date of evaluation | IMT | SC | IPC | CM | HR | CEHR | SUR | CMM | LSP | LS | ESS | SW | CI | Overall readiness |
|------------------|--------------------|-----|----|-----|----|----|------|-----|-----|-----|----|-----|----|----|-------------------|
| UDUTH            | 01.04.20           | 50  | 100| 70  | 80.8| 81.8| 75.0 | 88.9| 100 | 75.0| 100 | 71.4| 40 | 77.3| 80.2            |
| DELSUTH          | 14.04.20           | 50  | 77.8| 100| 68.2| 87.5| 83.3| 80  | 62.5| 60  | 57.1| 100 | 36.4| 76.2|                |
| FMCA             | 20.04.20           | 16.7| 11.1| 32.5| 11.5| 0  | 25  | 38.9| 45  | 58.3| 45  | 21.4| 0  | 63.6| 31.1            |
| AKTH             | 28.04.20           | 66.7| 83.3| 85  | 69.2| 40.9| 50  | 55.6| 70  | 66.7| 35  | 42.9| 0  | 50  | 59.7            |
| CHW              | 06.05.20           | 66.7| 55.6| 92.5| 85.8| 68.2| 87.5| 83.3| 95  | 79.2| 85  | 71.4| 100| 68.2| 81.1            |
| ATBUTH           | 15.05.20           | 50  | 83.3| 85.0| 80.8| 59.1| 62.5| 61.1| 50  | 66.7| 65  | 71.4| 30 | 50  | 66.5            |
| NDUTH            | 16.05.20           | 100 | 66.7| 95.0| 69.2| 59.1| 100 | 77.8| 70  | 62.5| 90  | 28.6| 50 | 31.8| 69.4            |
| UATH             | 25.05.20           | 33.3| 66.7| 97.5| 76.9| 81.8| 100 | 83.3| 80  | 70.8| 85  | 100 | 70 | 22.7| 76.6            |
| FMCBK            | 25.05.20           | 66.7| 88.9| 85  | 76.9| 40.9| 100 | 77.8| 55  | 58.3| 70  | 78.6| 30 | 36.4| 66.9            |
| UPTH             | 26.05.20           | 100 | 55.6| 85  | 80.8| 86.4| 62.5| 77.8| 100 | 87.5| 100 | 78.6| 60 | 45.5| 79.4            |
| GHG              | 16.06.20           | 16.7| 27.8| 40  | 15.4| 18.2| 25.0| 5.6 | 20  | 41.7| 5.0 | 7.1 | 0  | 95.5| 28.2            |
| ASYBSHG          | 17.06.20           | 100 | 55.6| 85  | 84.6| 77.3| 100 | 94.4| 85  | 83.3| 65  | 100 | 60 | 45.5| 78.2            |
| UCH              | 01.08.20           | 50  | 61.1| 62.5| 76.9| 50  | 50  | 100 | 75  | 70.8| 95  | 71.4| 40 | 31.8| 66.1            |
| UNTH             | 17.08.20           | 100 | 77.8| 92.5| 96.2| 90.9| 87.5| 100 | 90  | 100 | 78.6| 80 | 54.6| 88.7            |
| UNTH             | 28.08.20           | 66.7| 88.9| 92.5| 73.1| 59.1| 87.5| 100 | 65.0| 45.8| 80  | 71.4| 80 | 45.5| 73.4            |
| ISTH             | 10.09.20           | 100 | 61.1| 87.5| 76.9| 77.7| 62.5| 83.3| 85.0| 75  | 90  | 92.9| 30 | 59.1| 77             |
| AIFUTH           | 18.09.20           | 100 | 44.4| 75  | 73.1| 40.9| 75.0| 61.1| 55.0| 58.3| 75  | 64.3| 50 | 68.2| 63.7            |
| ESUTH            | 08.10.20           | 50  | 50  | 50  | 50  | 40.9| 50  | 72.2| 80  | 54.2| 40  | 71.4| 60 | 27.3| 52.4            |
| FMCY             | 13.10.20           | 50  | 55.6| 100 | 73.1| 59.1| 87.5| 100 | 65  | 41.7| 40  | 28.6| 50 | 77.3| 67.3            |
| GHM              | 29.10.20           | 66.7| 55.6| 67.5| 61.5| 59.1| 25  | 72.2| 55  | 45.8| 65  | 42.9| 20 | 31.8| 54.4            |
| All Hospitals    |                    | 66.7| 61.1| 85  | 76.9| 59.1| 75  | 80.6| 72.5| 64.6| 72.5| 71.4| 50 | 47.7| 68.4            |

NB: Names of hospitals: Usman Danfodio University Teaching Hospital (UDTH), Sokoto, Delta State University Teaching Hospital, Delta (DELSUTH), Federal Medical Centre Abeokuta, Ogun State (FMCA), Aminu Kano Teaching Hospital, Kano (AKTH), Niger Delta University Teaching Hospital, Bayelsa (NDUTH), Central Hospital, Warri, Delta (CHW), Abubakar Tafewa Balewa University Teaching Hospital, Bauchi (ATBUTH), University of Port Harcourt Teaching Hospital, Rivers (UPTH), University of Abuja Teaching Hospital, FCT (UATH), Federal Medical Centre Birnin Kebbi (FMCBK), General Hospital Gusau, Zamfara (GHG), Ahmed Sani Yariman Bakura Specialist Hospital, Zamfara (ASYBSH), University College Hospital Ibadan, Oyo (UCH), University of Maiduguri Teaching Hospital, Borno (UMTH), University of Nigeria Teaching Hospital, Enugu (UNTH), Alex Ekwoemu Fed. University Teaching Hospital, Eboinyi (AEIFUTH), Irrua Specialist Teaching Hospital, Edo (ISTH), Enugu State University Teaching Hospital, Enugu (ESUTH), Federal Medical Centre Yenagoa, Bayelsa (FMCY), General Hospital, Minna, Niger State.

Components of readiness checklist: IMT (Incident Management Team), SC (Surge Capacity), IPC (Infection Prevention and Control), CM (Case Management), HR (Human Resources), CEHR (Continuity of Essential Health Services and Patient Care), SUR (Surveillance: Early Warning Sign and Monitoring), CMM (Communication), LSP (Logistic and Management of Supplies, Including Pharmaceuticals), LS (Laboratory Services), ESS (Essential Support Services), SW (Staff Welfare), CI (Critical Items).

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Fig 1. Radar chart of readiness scores (%) of 13 components of WHO modified COVID-19 hospital readiness checklist among 20 hospitals in Nigeria.

Table 3. Implementation of incident management plan and surge capacity readiness indicators among 20 hospitals in Nigeria.

| Sn | Hospital readiness indicator                                                                 | Completed | In progress | Due for review | Not started |
|----|-----------------------------------------------------------------------------------------------|-----------|-------------|----------------|-------------|
|    | Incident management plan                                                                     |           |             |                |             |
| 1  | Hospital has an Emergency Response Plan                                                        | 40        | 40          | 5              | 15          |
| 2  | Hospital has an Emergency operation centre                                                    | 35        | 25          | 5              | 35          |
| 3  | Hospital has established an incident management committee or response team for COVID-19      | 70        | 20          | 5              | 5           |
|    | Surge capacity                                                                                |           |             |                |             |
| 1  | Hospital has estimated its capacity to accommodate COVID-19 surge                            | 45        | 5           | 40             | 10          |
| 2  | Hospital has identified ways of expanding hospital in-patient capacity                        | 50        | 0           | 40             | 10          |
| 3  | Hospital has identified potential gaps in the provision of health care, especially critical care| 40        | 5           | 50             | 5           |
| 4  | Hospital has developed strategies to address challenges associated with critical care       | 35        | 5           | 55             | 5           |
| 5  | Hospital has considered outsourcing care of non-critical patients to alternative treatment sites| 25        | 0           | 35             | 40          |
| 6  | Hospital, in conjunction with local authorities, has identified other sites for patient care | 20        | 10          | 15             | 55          |
| 7  | Hospital has considered cancelling nonessential services (e.g., elective surgery) when necessary | 80        | 5           | 10             | 5           |
| 8  | Hospital has prioritized patient care according to available treatment capacity and demand    | 75        | 0           | 20             | 5           |
| 9  | Hospital has considered setting up isolation tents to cater for a surge in patients’ numbers   | 30        | 10          | 35             | 25          |

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precautions, while only 40% reported having adequate personal protective equipment (PPE) for HCW.

**Case management**

Regarding case management, 16 hospitals (80%) were providing patient care following national and international guidelines and had established triage protocol and implemented strategies for admission, internal transfer, referral, and discharge of COVID-19 patients (Table 5). However, only 45% of hospitals had established a triage station at the entrance to their facility and 55% of hospitals had made available staffed beds for admission of severe COVID-19 cases and designated an exclusive waiting and examination area for individuals presenting with respiratory symptoms and/or fever (Table 5).

**Human resources and staff welfare**

About 70% of hospitals each had a clear policy on staff exposure and staff suspected or confirmed of COVID-19, 60% had identified number of HCW needed for operation of all units and 60% had prioritized staffing by unit and distributed personnel accordingly (Table 6). About 75% of hospitals had provided relevant training to ensure staff competency and safety. However, only 20% of hospitals had multidisciplinary psycho-social teams to support families of staff and patients, while just one (5%) hospital had addressed liability, insurance and temporary licensing issues regarding staff working outside their areas of expertise.
### Table 5. Implementation of COVID-19 case management readiness indicators among 20 hospitals in Nigeria.

| Sn | Hospital readiness indicator | Completed | In progress | Due for review | Not started |
|----|-----------------------------|-----------|-------------|----------------|-------------|
| 1  | Hospital has implemented triage, early recognition, and source control (isolating patients with suspected COVID-19) | 65 | 5 | 25 | 5 |
| 2  | Hospital has established a triage station at the entrance of the health-care facility | 45 | 15 | 30 | 10 |
| 3  | Hospital has adopted screening questionnaires and post signs reminding symptomatic patients to alert HCWs | 45 | 10 | 20 | 25 |
| 4  | Hospital has designated an exclusive waiting and examination area for persons with respiratory symptoms and/or fever | 55 | 0 | 20 | 25 |
| 5  | Hospital has appointed a supervisor to oversee all triage operations | 70 | 5 | 5 | 20 |
| 6  | Hospital has established a triage protocol to identify acute respiratory infections | 80 | 0 | 10 | 10 |
| 7  | Hospital has implemented a strategy for the admission, internal transfer, referral, and discharge of COVID-19 patients | 85 | 5 | 0 | 10 |
| 8  | Hospital has made available staffed beds for admission of severe COVID-19 cases | 55 | 10 | 20 | 15 |
| 9  | Hospital has made available oxygen, respiratory support, and sedation for intubated patients | 45 | 5 | 40 | 10 |
| 10 | Hospital is providing care following national and international guidelines | 80 | 0 | 20 | 0 |
| 11 | Hospital has communicated admission criteria/triage logistics to relevant authorities | 65 | 5 | 25 | 5 |
| 12 | Hospital personnel are aware of protocols for off-license use of medicines. | 25 | 10 | 30 | 35 |
| 13 | Hospital has established a communication line (e.g., intercom, bed alarm) for patients to call the attention of staff on duty | 30 | 15 | 20 | 35 |

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### Table 6. Implementation of human resources and staff welfare readiness indicators among 20 hospitals in Nigeria.

| Sn | Hospital readiness indicator | Completed | In progress | Due for review | Not started |
|----|-----------------------------|-----------|-------------|----------------|-------------|
| 1  | Hospital has updated the staff contact list | 35 | 5 | 35 | 25 |
| 2  | Hospital anticipated staff absenteeism in advance and monitored it continuously | 25 | 15 | 45 | 15 |
| 3  | Hospital has a clear policy on staff exposure and staff suspected or confirmed of COVID-19 | 70 | 0 | 20 | 10 |
| 4  | Hospital has identified number of HCWs needed for operation in all units | 60 | 5 | 20 | 15 |
| 5  | Hospital has prioritized staffing by unit and distributed personnel accordingly | 60 | 5 | 30 | 5 |
| 6  | Hospital has recruited and trained additional staff according to need | 25 | 0 | 10 | 65 |
| 7  | Hospital has familiarized staff to work in high-demand areas to support surge | 45 | 5 | 30 | 20 |
| 8  | Hospital has provided relevant training to ensure staff competency and safety | 75 | 0 | 20 | 5 |
| 9  | Hospital has multidisciplinary psycho-social teams to support families of staff and patients | 20 | 0 | 25 | 55 |
| 10 | Hospital addressed liability, insurance and temporary licensing issues regarding staff working outside their areas of expertise | 5 | 0 | 20 | 75 |
| 11 | Hospital has considered reassigning staff at high risk for complications of COVID-19 | 60 | 5 | 20 | 15 |

#### Staff welfare

| Sn | Hospital readiness indicator | Completed | In progress | Due for review | Not started |
|----|-----------------------------|-----------|-------------|----------------|-------------|
| 1  | Hospital has secure accommodation for staff involved in the care of COVID-19 cases | 25 | 0 | 25 | 50 |
| 2  | Hospital has plans to cater for feeding of staff dedicated for COVID-19 care | 50 | 10 | 10 | 30 |
| 3  | Hospital has plans for any prophylaxis for staff caring for COVID-19 patients | 35 | 5 | 30 | 30 |
| 4  | There is a special remuneration for staff involved in COVID-19 patient care | 40 | 10 | 25 | 25 |
| 5  | There is a health/life insurance for staff involved in COVID-19 patient care | 10 | 10 | 30 | 50 |

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Nine (50%) hospitals had plans to cater for feeding of staff dedicated to COVID-19 care (Table 6). Only 25% and 10% of hospitals had secured accommodation for staff involved in care of COVID-19 cases and provided health/life insurance for staff involved in COVID-19 patient care, respectively.

**Continuity of essential health services, and surveillance**

Table 7 shows that most hospitals (70%) maintained essential hospital services while only 30% have listed all hospital services in order of priority. Regarding surveillance, 80% of hospitals ensured COVID-19 testing is done in line with national criteria but only eight hospitals (40%) each have appointed a hospital epidemiologist to coordinate surveillance and identified the information that needs to be collected and defined the objectives for its use (Table 7).

**Communication**

Twelve hospitals (70.6%) ensured decisions related to management of COVID-19 are communicated to all relevant staff and stakeholders, 55% have briefed staff on their roles and responsibilities regarding care of COVID-19 and 60% have appointed a public information spokesperson to coordinate communication (Table 8).

**Logistic, supplies and pharmaceuticals**

About 40% of hospitals had an updated inventory of all equipment, supplies, and pharmaceuticals, and reordering mechanism. Only seven hospitals (35%) had estimated the consumption of essential equipment, supplies, and pharmaceuticals and 25% had established contingency agreements with vendors to ensure the procurement and prompt delivery of equipment, supplies, and other resources (Table 9).
Laboratory services and essential support services

Sixteen (80%) hospitals had ensured the continuous availability of basic laboratory testing, but only seven hospitals (40%) had established a laboratory referral pathway for the identification, confirmation, and monitoring of COVID-19 (Table 10). About 70% of hospitals had trained staff on specimen handling, packaging, and transportation procedures for specimen referrals, 50% of hospitals had established a biosafety level 2 or higher laboratory for diagnosis of infectious diseases, and 40% had the capability to test for COVID-19.

Table 8. Implementation of communication readiness indicators among 20 hospitals in Nigeria.

| Sn | Hospital readiness indicator | Completed | In progress | Due for review | Not started |
|----|--------------------------------|-----------|-------------|----------------|-------------|
| 1  | Hospital established mechanisms for sharing of information between the hospital administration, department, and facility staff | 70        | 5           | 20             | 5           |
| 2  | Hospital has briefed staff on their roles and responsibilities regarding care of COVID-19 patients | 55        | 5           | 30             | 10          |
| 3  | Decisions on clinical triage and related policies are communicated to relevant staff and stakeholders | 65        | 10          | 20             | 5           |
| 4  | Hospital has ensured analysis and reporting of information to supervisory stakeholders | 55        | 0           | 35             | 10          |
| 5  | Hospital has drafted key messages on COVID-19 targeting different audiences | 50        | 5           | 35             | 10          |
| 6  | Hospital has appointed a public information spokesperson to coordinate communication | 60        | 10          | 20             | 10          |
| 7  | Hospital has reliable communication systems and access to updated contact lists | 35        | 10          | 35             | 20          |
| 8  | Hospital has considered having a contact list with roles rather than specific people | 20        | 10          | 35             | 35          |
| 9  | Hospital is familiar with referral mechanisms from national level and related mechanisms | 55        | 5           | 30             | 10          |
| 10 | Hospital has mechanisms to streamline the sharing of information between the hospital administration, departments/units/staffs | 70        | 0           | 30             | 0           |

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Table 9. Implementation of logistic and management of supplies, including pharmaceuticals readiness indicators among 20 hospitals in Nigeria.

| Sn | Hospital readiness indicator | Completed | In progress | Due for review | Not started |
|----|--------------------------------|-----------|-------------|----------------|-------------|
| 1  | There is an updated inventory of all equipment, supplies, and pharmaceuticals; and reordering mechanism | 40        | 10          | 40             | 10          |
| 2  | Hospital has estimated the consumption of equipment, supplies, and pharmaceuticals based on most likely outbreak scenario | 35        | 10          | 40             | 15          |
| 3  | Hospital has consulted with authorities to ensure the continuous provision of essential medications and supplies | 40        | 15          | 35             | 10          |
| 4  | Hospital has assessed the quality of contingency items prior to purchase | 40        | 15          | 30             | 15          |
| 5  | Hospital has contingency agreements with vendors to ensure the procurement and prompt supply of resources as required | 25        | 5           | 40             | 30          |
| 6  | Hospital has identified physical space within the hospital for the storage and stockpiling of additional supplies | 65        | 10          | 25             | 0           |
| 7  | Hospital has considered accessibility, security, temperature, ventilation, and humidity, and ensured an uninterrupted cold chain for essential refrigerated items | 50        | 15          | 25             | 10          |
| 8  | Hospital has stockpiled essential supplies and pharmaceuticals, with timely use of items to avoid loss due to expiration | 40        | 15          | 35             | 10          |
| 9  | The role of hospital pharmacy in providing pharmaceuticals for home or other alternative treatment is defined | 50        | 10          | 25             | 15          |
| 10 | There is a mechanism for timely maintenance/repair of the essential equipment and deferment of non-essential maintenance | 45        | 20          | 30             | 5           |
| 11 | Hospital has established a contingency transportation strategy for continual patient transfers, such as designated ambulance teams | 45        | 25          | 15             | 15          |
| 12 | Hospital has ensured there is a policy in place for managing donations of medical supplies, food for staff, etc. | 45        | 15          | 20             | 20          |

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About 50% of hospitals had ensured the availability of appropriate back-up arrangements for water, power, and oxygen. Less than 40% of hospitals had designated an area for use as a temporary morgue and formulated a post-mortem care contingency plan with appropriate partners.

### Availability of critical items

Most of the hospitals evaluated reported inadequate supplies of critical items related to COVID-19 care. Only three hospitals reported having adequate supplies of PPE. Less than 25% of hospitals had adequate supplies of fingertip pulse oximeters and nasal prongs for oxygen delivery (Table 11).

### Discussion

The WHO COVID-19 hospital readiness checklist was developed for hospital leaders to rapidly determine their current capacities and gaps in services necessary to respond to the COVID-19 pandemic, to help them identify major areas that require investment and action, and to develop plans to improve hospital readiness [11].

Our study findings have revealed gaps in infrastructure, equipment, human resources, processes, and procedures related to COVID-19 response among both secondary and tertiary hospitals.
Health facilities in Nigeria. These gaps persisted even among hospitals evaluated five to eight months after the first case of COVID-19 was reported in the country.

Any successful response to a public health threat is driven by an evidence-based emergency response plan (ERP) implemented by an incident management team and coordinated through an emergency operations centre (EOC) [12, 13]. Even though majority of the hospitals surveyed had a COVID-19 incident management teams at the time of evaluation, less than eight hospitals had a COVID-19 ERP or EOC. Lack of planning and inadequate coordination of information and resources for the COVID-19 response as provided by an ERP and EOC could partly explain the predominant ‘moderately ready’ and ‘not ready’ COVID-19 readiness scores by hospitals in our study. Pre-existing gaps in various service delivery elements also played a major role in the poor readiness scores. For instance, for each hospital surveyed, there was a median of 15 isolation beds, four ICU beds, four ventilators and between one to seven COVID-19-related specialist human resources. This suggest that most hospitals even lacked resources for routine patient care before the COVID-19 pandemic and were not prepared to accommodate a surge in cases of COVID-19.

In the face of the COVID-19 pandemic, an effective hospital emergency response should sustain all essential health services, be able to expand hospital facilities and resources for surge of severe and critical cases of COVID-19, and provide a safe and motivating environment for staff [5]. Although over 80% of hospitals in our study had cancelled non-essential health services, while about 70% had maintained essential health services, majority of hospitals had no plans to expand hospital in-patient capacity, no plans for critical care of COVID-19 patients and no plans for a temporary morgue for deceased patients. There were significant gaps in logistics and supplies as over 60% of hospitals had neither estimated consumption of hospital commodities nor established contingency agreement for procurements. Staff welfare was also inadequate as only five of the 20 hospitals surveyed had secured accommodation for staff involved in COVID-19 care, only four hospitals had multidisciplinary psycho-social teams to support families of staff and patients, and only two hospitals had provided health or life insurance for staff involved in COVID-19 patient care. Majority of hospitals surveyed reported a lack or paucity of critical items for COVID-19 response. For instance, about 65% of hospitals reported not having adequate supplies of full PPE and surgical masks for use by HCWs, while 25% of hospitals did not have supplies of PPE.

Table 11. Availability of critical items for COVID-19 response among 20 hospitals in Nigeria.

| Hospital readiness indicator                                                                 | Yes, adequate | Yes, but not adequate | No |
|---------------------------------------------------------------------------------------------|---------------|-----------------------|----|
| Hospital has supplies of full PPEs                                                         | 15            | 60                    | 25 |
| Hospital has supplies of surgical mask                                                      | 10            | 65                    | 25 |
| Hospital has supplies of N95 mask (particulate respirator)                                  | 20            | 55                    | 25 |
| Hospital has fingertip pulse oximeter for management of COVID-19 patients                    | 15            | 65                    | 20 |
| Hospital has oxygen concentrators for management of COVID-19 patients                        | 30            | 40                    | 30 |
| Hospital has ventilators for management of adults and paediatric age group COVID-19 patients| 30            | 50                    | 20 |
| Hospital has adequate quantity of CPAP 10 machine, with twin flowmeters for management of COVID-19 patients | 50            | 25                    | 25 |
| Hospital has CPAP unit with nasal tubing and mask for adult for management of COVID-19 patients | 45            | 30                    | 25 |
| Hospital has Flowmeter, Thorpe tube, for oxygen 0-15L/min for management of COVID-19 patients | 35            | 45                    | 20 |
| Hospital has suction pump, mechanical (twin pump) for management of COVID-19 patients        | 30            | 45                    | 25 |
| Hospital has high flow nasal cannula for management of COVID-19 patients                    | 25            | 30                    | 45 |

NB: PPE-personal protective equipment, CPAP-continuous positive airway pressure

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Our study findings also reveal that COVID-19 instigated some improvement in hospital infrastructure, especially among hospitals who established isolation units and procured ventilators for the first time due to the COVID-19 pandemic. The highest readiness scores were reported for IPC and surveillance. The reasons for these high scores are not obvious from our study findings. Possibly, hospitals prioritized implementation of activities under these components as they are related to detection and prevention of COVID-19 infection among patients and staff. However, reported implementation does not necessarily imply compliance. For instance, only 50% of hospitals surveyed had certified that their HCWs were applying standard precautions. The reported inadequacies in PPEs also suggest that compliance with IPC was limited among HCWs.

Our study findings are comparable to other published literature from within and outside Nigeria. At the onset of the COVID-19 pandemic, the WHO assessed the readiness status of 48 African countries to respond to COVID-19, revealing that 8 (16.7%) had adequate readiness, 33 (68.8%) had moderate readiness and 7 (14.6%) had limited readiness status [10]. Nigeria was ‘moderately’ ready, but the country scored below average in four out of the nine pandemic readiness checklists, including surveillance, case management, IPC, and rapid response team. A mid-term (February to June 2020) review of Nigeria’s COVID-19 multisectoral response identified challenges relating to delay in supply of PPEs, inadequate health infrastructure, disrupted supply chains and increased cost of procurement, among other challenges [14]. The challenges of inadequate PPEs, unpaid COVID-19 hazard allowances and other poor welfare issues, compelled resident doctors in Nigeria to embark on a national strike in June 2020 [15].

Other national studies from developing countries, including Malawi [16], Kenya [17], India [18], and Nepal [19], have largely reported variable levels of unpreparedness for COVID-19 response due to gaps in availability of PPEs, inadequate isolation facilities and poor readiness for critical care of COVID-19 patients, among other challenges. However, COVID-19 also overwhelmed strong health systems of developed countries. A national review of United States of America (USA) hospital experiences to the COVID-19 pandemic conducted in March 2020, revealed that majority of US hospitals had challenges related to patient care, expanding facility capacity, availability of PPEs and staff safety [20]. A COVID-19 preparedness health facility assessment from Ukraine revealed that less than 50% of hospitals had isolation units and over 80% of hospitals lacked surgical masks for use by HCWs [21]. Another study from Iran reported an overall readiness score of 42% among 24 hospitals, with gaps in almost every element of the readiness checklist [22]. In a survey on continuity of essential health services during COVID-19 conducted among 105 countries between May and July 2020, disruptions in services were more common among low- and middle-income than in high-income countries [23]. Among the 105 countries surveyed, 90% reported at least partial disruptions in one or more essential health services, 44% reported insufficient PPEs for HCWs and 30% reported interruptions in the supply of medical equipment and health products.

Our study has some limitations. The date of assessment of hospital readiness was not uniform among hospitals surveyed, making it impossible to assess true variability of readiness among hospitals. However, the variability in the date of evaluation provides a picture of how hospitals have responded within two to eight months after the first case of COVID-19 was reported in Nigeria. The checklist was completed by designated representatives of the hospital and their responses were not independently verified. Consequently, the possibilities of response bias cannot be excluded. We only included three secondary health facilities in our study, and our findings among these hospitals may not be generalizable to similar healthcare facilities in the country.

Notwithstanding these limitations, our study is the first from Nigeria evaluating readiness of hospitals to respond to the COVID-19 pandemic. Our results reveal that most hospitals...
surveyed were not adequately ready for the COVID-19 pandemic, with variability among hospitals and a general poor state of readiness in relation to surge capacity, critical care, human resources, staff welfare and availability of critical items for COVID-19 response. While Nigeria continues to improve its hospital readiness for COVID-19, [14] sustainable interventions that address challenges related to management of severe and critical cases in health care facilities, including improved health workforce for epidemic response, construction of well-equipped ICUs in all states of the federation, provision of adequate supplies of PPEs for HCWs and attention to improvement of staff welfare and safety are required.

Supporting information

S1 Text. Hospital readiness survey questionnaire during COVID-19 in Nigeria.
(DOCX)

S1 File. Hospital readiness survey data.
(SAV)

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