

Published: May 31, 2023

Citation: Ogunbiyi O, Akhideno I, et al., 2023. The Post Coronavirus Disease-19 Pandora-Box: Future Directions for Critical Care in Low and Medium-Income Countries, Medical Research Archives, [online] 11(5). <https://doi.org/10.18103/mra.v11i5.3775>

Copyright: © 2023 European Society of Medicine. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

DOI
<https://doi.org/10.18103/mra.v11i5.3775>

ISSN: 2375-1924

RESEARCH ARTICLE

The Post Coronavirus Disease-19 Pandora-Box: Future Directions for Critical Care in Low and Medium-Income Countries.

Obashina Ogunbiyi, MD, FWACS¹, **Irene Akhideno**, FMCA², **Omolola Fagbohun**, FWACS³, **Akintayo Ogunjuboun**, FMCA³

¹ Department of Intensive Care, Mainland Hospital, Yaba, Lagos, Nigeria

² Department of Anaesthesia, Irrua Specialist Teaching Hospital, Irrua, Edo State, Nigeria

³ Department of Anaesthesia, Lagos State University Teaching Hospital, Ikeja, Lagos, Nigeria

Corresponding Author: Dr. Obashina Ogunbiyi

E-mail: gasweez@yahoo.com

ABSTRACT

The novel Coronavirus disease-19, caused by the Severe Acute Respiratory Syndrome-Coronavirus-2 virus posed a worldwide public health emergency and remains a large health burden till date in some continents, causing a significant morbidity and mortality among the critically-ill, not sparing the low and medium-income countries. The critical care surge in most countries exposed the unpreparedness and “struggling” health systems of these countries, including Low and medium-income countries in containing the epidemic. The suddenness of Coronavirus disease in China is suggestive that another “Pathogen X” epidemic may occur. In addition, the increasing global terrorism index may precipitate another epidemic secondary to a bioterrorism contagion. In mitigating this, however, lessons learnt from the management of the critically-ill patients with the Coronavirus disease may assist the low and medium-income countries in charting the future directions of critical care in the event of any Post Coronavirus disease public health challenge. The import of systems approach and collaboration with development partners cannot be over-emphasized, alongside increasing critical care beds and improving oxygen availability and accessibility. Finally, changing the narrative of “struggling” health systems of developing countries by addressing the major debilitating factors, including the issue of critical care workforce and training is needed. The new Essential and Emergency Critical Care training program is proffered. Furthermore, offering skilled healthcare workers adequate remuneration and other incentives to guard against their migration to “greener pastures” may help the low and middle-income countries retain critical care specialists in preparing for any sudden Post-Coronavirus disease public health emergency.

Keywords: Coronavirus disease-19, Low and medium-income countries, Critical care, Bioterrorism, Systems approach

Introduction

The COVID-19 disease is a novel coronavirus infection affecting the respiratory system and is caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). It caused a worldwide public emergency and was proclaimed by the World Health Organization (WHO) as a pandemic in March 2020.^{1,2} It presented a large health burden and continues to ravage the world.³ Although COVID-19 had posed a huge problem to most developed countries, the African continent and some other “Low and Medium-income Countries” (LMICs) were not spared.⁴ It also starred significant morbidity and mortality, with attendant economic disasters. In Lagos, which was the epicenter of the COVID-19 challenge in Nigeria, a study on the morbidity and mortality pattern following COVID-19 revealed that the epidemiological characteristics appear worsened in hypertensive patients with COVID-19, where survival rates were significantly lowered by the presence of additional co-morbidity to 50% from 91% for those with hypertension alone.⁵

In combating the effect of the substantial morbidity and apparent socio-economic impact of the pandemic in the early days, with attendant lack of vaccine, many prevention strategies were put in place. These include deliberate testing, contact tracing and social restrictions, in the form of lockdowns and these were adopted globally.⁶ LMICs, including African countries, on their part implemented additional measures such as school closures, international and even inter-city travel bans, curtailing of large gatherings, including churches and mosques.⁷

Globally, over 755million confirmed cases have been recorded, with over 6.8million deaths as at 10 February 2023.⁸ Nigeria, with an estimated population of about 206million had recorded 266,463 confirmed cases and 3,155 deaths by same date,⁹ Deaths in LMICs from the COVID-19 can be attributed to dearth of appropriate critical care intervention for severe cases of the disease, that is those that need intensive care admission. According to Ogunbiyi et al,¹⁰ there is lack of infrastructure and skilled manpower in most ICUs of developing countries. This may have accounted for the apparent mortality in severe cases of COVID-19 in most of the developing countries.

In severe forms of the COVID-19 disease the manifestations include features of severe chest discomfort with breathlessness and those of acute respiratory distress syndrome (ARDS). Thus, intensive care unit admission is ultimately indicated to treat ARDS, shock, acute kidney injury and multiple organ failure. Management of these critical or severe cases may take about 3-6 weeks

and may end up with significant morbidity or even mortality. The treatment of COVID-19 is mainly supportive and when patient becomes hypoxic, oxygen is provided with either nasal prongs, face or venti-mask or non-rebreathing bags. In severe hypoxic patients, the high flow nasal cannula, non-invasive ventilation or infact elective mechanical ventilation may be indicated while in the intensive care unit.

It is pertinent to note that some broad-spectrum anti-viral agents such as Remdesivir showed some benefits in the treatment of COVID-19. Some immune-modulators such as Tocilizumab (an IL-6 inhibitor) were also used, especially when inflammatory markers such as D-Dimer are elevated, in severe cases of COVID-19. However, these drugs are very expensive and were only used in few private hospitals or centres where the patients could afford the procurement, as they are not readily ordinarily available in the hospital Pharmacy store. Another development which greatly improved the management of the patients with severe COVID-19 in LMICs was the use of low-dose dexamethasone which was found to have reduced mortality in these patients by 35% in ventilated patients, according to the RECOVERY Trial conducted in the United Kingdom.¹¹

There had been previous pandemics that affected many continents but these were caused by bacteria. A most recent example of this was the plague that claimed a lot of lives in 1893, as well as the Cholera pandemics in the course of the 19th Century.¹²

The Spanish flu of 1918 led to a lot of mortality in most continents including Africa.¹² More recently, in the 21st Century and reminiscent of the COVID-19 pandemic are the SARS-CoV-1 and the Middle East Respiratory Syndrome (MERS). These epidemics have almost the same clinical presentation as COVID-19.

The suddenness in which the COVID-19 started in China in December 2019 and gradually devastated countries globally as a result of human-to-human droplet infection coupled with the increasing severity of respiratory symptoms from previous SARS-COV infection is a pointer that there could be another “Pathogen X” that may follow the apparent containment of the COVID-19 disease and this on its own may open the “Pandora Box” to a more severe global health systems challenge. Furthermore, the increasing global terrorism index is something to be worried about, as a contagion can be used as a bioterrorism agent to cause disaffection in the body politic of the nations. The effect of this on developing countries cannot be over-emphasized if and when it occurs. This review therefore will

look into evidence-based ways of preparing for another pandemic that may involve the respiratory system more virulently than the COVID-19 disease. This will be achieved through discussing some lessons learnt during the COVID-19 pandemic in LMICs and highlighting steps that may assist these developing countries contain or manage severely-ill patients with this Post COVID-19 pandemic in the critical care space.

Lessons Learnt From COVID-19 In LMICs

Most LMICs became resilient in the course of the COVID-19 pandemic but this was not without an initial confusion as to the causation of the disease, the daunting challenges of myths and fictions surrounding the disease in the tropics as well as the apparent lack of facilities to manage the most severe of the cases that presented in the various isolation centres, some without accredited COVID-19 intensive care units. The COVID-19 imbroglio brought in its stride challenges to many healthcare systems across many LMICs necessitating adaptability. Some of the important lessons learnt in the course of the COVID-19 containment had impacted on how we practice and provide critical care in a “new normal” environment and also led to improvement in the management of the disease in the latter “waves” of the pandemic. Some of these include:

a. Non-preparedness. Most LMICs were practically not prepared for such surge and response. It is pertinent to note that most health systems in LMICs are plagued with a lot of challenges prior to the onset of the COVID-19 pandemic. These include, among other things, workforce deficiencies in the healthcare sector which the migration of skilled healthcare workers to “greener pasture” may have caused.^{13,14} One of the ways of mitigating this is by encouraging local training of relevant skilled healthcare manpower to improve the availability of critical care specialists and nurses. The United Nations Economic Commission for Africa expressed some fears in April 2020 that the continent of Africa could experience as much as 123 million cases of COVID-19 with attendant deaths of 300,000 from

the disease in 2020, because of the non-preparedness of their health systems, which are also ill-equipped.¹⁵ This however, did not happen.

b. Deficient Critical Care Beds and Consumables.

Before the COVID-19 pandemic, there was an abysmal number of available critical care beds in most LMICs. This has made intensive care unit outcomes worse in most LMICs, especially in Africa, because of lack of resources to procure these specialized beds, contributing to the inability to achieve minimum standards of care. According to a retrospective study done in Uganda, there is 0.1 ICU bed per 100,000 population.¹⁶ In addition, Ethiopia, located in the horn of Africa and noted for early civilization, according to a comprehensive survey of 51 public hospitals revealed 0.3 ICU bed per 100,000 population, with majority of the beds situated in the capital.¹⁷ A cross-sectional study done in Ghana shows 0.5 ICU bed per 100,000 people.¹⁸ Comparatively, high-income countries record between 5-30 intensive care unit beds per 100,000 population.¹⁹ This perceived gap in the inadequacy of ICU bed capacity has contributed to the high mortality recorded in most LMICs during the COVID-19 pandemic. Many reasons can be adduced for the limited critical care services in LMICs, especially in Africa. Two important reasons are lack of recognition of the value of critical care to the whole healthcare system and inadequate funding for this service. Engagement of critical care specialists with policy-makers is advocated to convey the import of critical care beds and services during public health emergencies such as we had during the COVID-19 challenge. This is even much more so in the preparation for another Post COVID-19 pandemic or incident. This approach helped in Nigeria after the containment of the COVID-19 where the Federal Government of Nigeria, after due advocacy by relevant stakeholders, committed funds for the procurement and installation of additional 10 fully-furnished critical care beds in each of its 57 public tertiary health facilities located throughout the country (See Figure below)

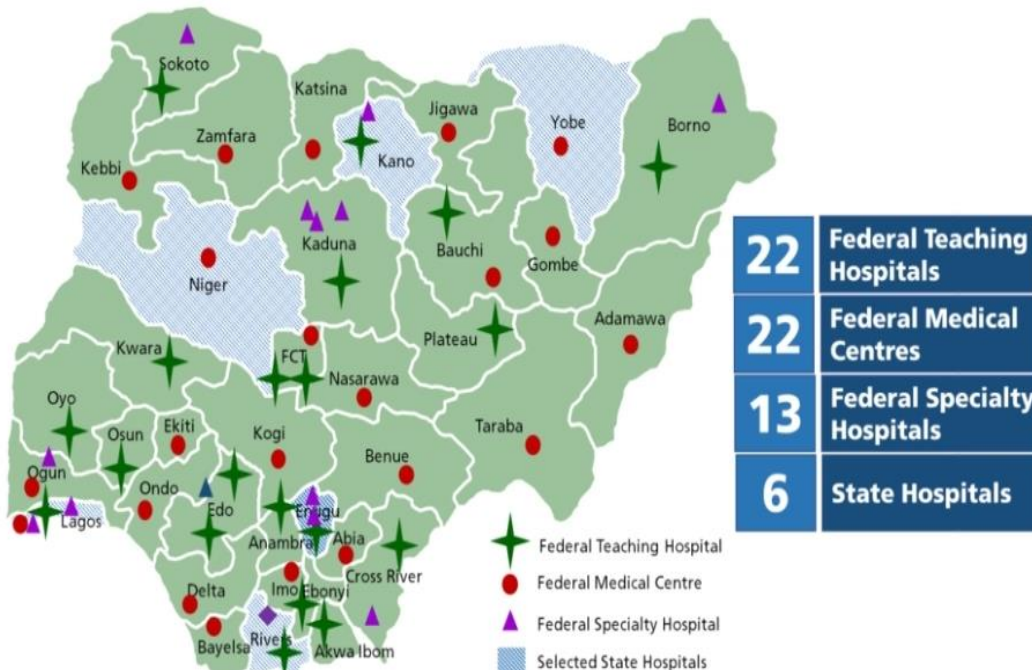


Figure: Distribution of Federal Tertiary Health Institutions across the 36 States of Nigeria and Abuja, the capital.

*Source: Vesta Healthcare Research and Analysis, 2019

c. Challenges in Oxygen Supply Chain. The mainstay of treatment of COVID-19 is oxygen. During periods of surges in respiratory pathologies, as during the COVID-19 pandemic, demand on oxygen supplies increased and much more in the extra-clinical capacity areas of the hospital. There were challenges in the production of oxygen, accessibility to the oxygen, especially in the face of lack or incorrect use of oxygen cylinders during the pandemic. In addition, compromised oxygen delivery to patients including incorrect clinical use may be harmful to patients who may not be hypoxaemic, for example myocardial infarction patients who are not PCR positive for COVID-19. In a study on respiratory techniques for COVID-19 patients in a sub-Saharan climate by Kwizera et al²⁰, it was revealed that in COVID-19 associated ARDS, mortality rates were highest in patients receiving non-invasive ventilation (NIV) or intermittent mechanical ventilation (IMV). They opined that because these patients are routinely sedated and usually ventilated in controlled modes made them very vulnerable to power cuts and interruptions in pressurized oxygen supply. Thus, in preparing for a Post COVID-19 pandemic or incident, LMICs should improve on their oxygen production, delivery and usage capabilities in “peace” time, with emphasis on oxygen delivery techniques, alternate power supplies (e.g solar), most

especially outside the ICU settings, as the case may require.

d. Dearth of skilled critical care personnel. There is a paucity of skilled critical care personnel in most sub-Saharan countries and this was one of the negative factors that contributed to an increased mortality during the erstwhile COVID-19 pandemic in LMICs. Many African countries rely on foreign-based Intensivists, who infrequently visit the tertiary hospital units to care for the critically-ill. Ogunbiyi et al¹⁰ in their study, revealed an obvious shortage of trained and certified Intensivists in the sub-Saharan hospitals cohort surveyed. A good way to mitigate this is to develop training and capacity-building programs in critical care for physicians, nurses and other relevant clinical staff in the intensive care unit setting.²¹ There are various programs that could be embarked upon but the “Train-the-Trainer” and “Peer-to-Peer” programs have been shown to be successful and could be further improved upon.²² Another option to mitigate this challenge is for LMICs to key into the Essential Emergency Critical Care training program that is fast gaining ground in Africa and other LMICs. It is tailored to emphasizing the care of the critically-ill patients, using available strategies.²³

e. Collaboration with Partners. One of the success stories of the management of the COVID-19 pandemic in most LMICs is the effective collaboration of the various nations’ Task Forces

and/or Emergency Operations Centres for COVID-19 response with international and continental health partners. In Nigeria, the Presidential Task Force (PTF) on COVID-19 Response had a robust collaboration with local and international development partners who offered technical and material support.²⁴ Some of these partners include the World Health Organization (WHO), Africa Centre for Disease Control (Africa CDC), in conjunction with the Nigeria Centre for Disease Control (NCDC), United Nations International Children Emergency Fund (UNICEF), the Clinton Health Access Initiative (CHAI) and other philanthropic organizations. The principal role of some of these partners include ensuring adequate infrastructure, in place for timely case detection, through their intervention in the surveillance and epidemiology, laboratory and case management pillars of the various Task Forces on COVID-19 Response. Following from the positive intervention of these development partners, they will be useful in planning any response in the event of any Post COVID-19 public health challenge.

f. Healthcare workers and engagement with policy-makers. Evidently, there was significant healthcare workers infection and re-infection in many LMICs during the COVID-19 “waves” of infection.²⁵ In most of these countries, a lot of healthcare workers initially hesitated to join in the response because of the novelty of the virus, whose patho-physiology was not well-elucidated in the early days. It took a while before strategies to curtail the virus spread such as social restrictions in the form of bans on inter-state travels, bans on religious and social gatherings, lockdowns and use of face masks among other things were effected. As a result of this, many healthcare workers became infected with the dreaded virus and governments had to introduce various forms of incentives to healthcare workers to encourage them to join in the ‘fight’ against the virus. This included financial motivations in the form of payment of “special” hazards allowance to relevant COVID-19 response volunteers. However, studies have revealed that when the incentives are relatively inadequate or non-existent, the level of commitment in the response to COVID-19 is abysmal.²⁶ Governments also promised healthcare workers PPEs, especially those working at the entry points into isolation centres and other health facilities. In some LMICs, there were some competing diseases of public health significance being attended to when the COVID-19 scourge emerged. This affected the response capability towards the new emergent viral disease with attendant poor political will. In Nigeria, the

government had been dealing with issues of Internally-displaced Persons (IDPs) in the North-eastern part of the country as a result of terrorism which had led to rising cases of the virus and the government had to introduce context-specific interventions to avert a looming health crisis. The NCDC was the primary agency that had to deal with government and policy-makers. The constructive engagement with the Federal Government of Nigeria ensured that there was immediate and positive response activities as soon as the WHO reported the SARS-CoV-2 outbreak as a Public Health Emergency of International concern (PHEIC) on 30th January, 2020.²⁷ In the course of the pandemic, many of the isolation centres had no or inadequate critical care beds, ventilators, lack of access to oxygen and in some cases, consumables and devices to minimize healthcare worker infection such as the Personal Protection Equipment (PPEs) and N95 masks which protects staff from particles of size 0.3µm or larger. In these cases, the Task Force officials had to engage the various States’ Ministry of Health for intervention. It is pertinent to state that there were some setbacks with respect to this in the early days. In Madagascar, the government launched a herbal medicine, an Artemisia extract, called “COVID-Organics” for the treatment of COVID-19 infection and even the WHO showed interest in it at a time.²⁸ However, it did not reduce nor “treat” the novel viral disease even in the country. It is possible that the healthcare workers in the country may not have appropriately engaged the government officials on the matter of the COVID-19 pandemic and its sequel. It is therefore imperative that healthcare workers should engage with government and policy-makers constructively in the event of any Post COVID-19 pandemic. Studies have shown that frontline health workers can experience an increased risk of mental challenges in the short and long term when attending to a larger number of patients under stressful conditions, as happened during the COVID-19 pandemic.²⁹ One of the challenges with service delivery during the COVID-19 pandemic was the absence of protocol to continually evaluate and manage frontline workers for psychological support. Task Forces on Response to public health emergency situations should have a strong Psycho-social pillar to address this issue.

Charting The Way Forward

It is well noted that from past experiences of pandemics, including SARS-CoV-1, MERS and even the most recent SARS-CoV-2 among others, LMICs have not fared particularly well. As these pandemics, more often than not, are

unpredictable, they pose considerable challenges to the “struggling” health systems of developing countries due to a number of debilitating factors. Thus to achieve a sound response to any Post COVID-19 challenge, they need to have well-developed strategies.

The value of having a robust preventive public healthcare system and curative health services cannot be over-emphasized in preparing for any foreseeable Post COVID-19 outbreak. In this light, the public trust in the government of being able to contain such an outbreak needs to be built during “peace” times. A way of doing this includes having strategic reserves of personal protective equipment, ICU devices, equipment, consumables and medication. Critical care is an essential part of healthcare delivery and this was clearly revealed in the early days of the dreaded COVID-19 pandemic, even in developed climes where the ratio of ICU beds per 100,000 of the population far outweighs that posited in LMICs. Although it is known that resources are limited in LMICs, a judicious use of available resources will be expected well ahead of any untoward Post COVID-19 public health emergency. It is therefore pertinent that they should invest in more ICU beds for treatment of critically-ill patients at this time that the public health space is “free”, following the containment of the COVID-19 scourge. As ICU bed capacity and occupancy is a veritable indicator of healthcare systems strain, LMICs should deliberately increase available ICU beds by establishing new bed spaces or even making sure extra spaces such as specialized wards have facilities for piped oxygen delivery and electrical power outlets to power these monitoring or ventilatory devices in the event of an upsurge in critically-ill patients in the hospital. There should also be an effective oxygen supply chain with efficient accessibility and utilization.

With the continued migration of skilled critical care staff in developing nations to “greener pastures”, ICU staffing needs to be urgently addressed holistically. An effective way to mitigate this may be by offering adequate remuneration to these skilled healthcare workers as a form of incentive within the available resources of the country. Other than financial incentives, a novel way of doing this may include offering educational scholarships to children of the selected staff in named and reputable public secondary and tertiary institutions. Sponsorship at academic conferences and workshops on an annual basis is another form of incentive.

Furthermore, the hallmark of managing a public healthcare emergency by LMICs is through the systems approach strategy via the establishment

of a central committee or task force with a command and control structure to be in charge of directing the day-to-day administration of the treatment and preventive measures against the offending pathogen, be it of a bacterial or viral source. The committee or task force should ideally be organized with skilled and knowledgeable public health specialists and other relevant stakeholders heading designated units such as the surveillance and epidemiology pillar, point-of-entry pillar, laboratory pillar, risk communication pillar, case management pillar, logistics pillar, psycho-social pillar and a research pillar, among others. These pillar leads must meet daily to update the government on the progress and challenges of the containment of the outbreak. The systems approach strategy should also incorporate collaboration with development partners such as the WHO, CHAI and other NGOs and philanthropists who have a role to play in ensuring early containment of such challenges. Considering the mental state of frontline health workers, the Task Force responsible for the response should design early supportive psychological interventions to mitigate mental health issues of volunteering healthcare workers.

As earmarked earlier, one of the challenges of managing such an envisaged outbreak is that of funding. It is hoped that governments will be held accountable and responsible for a judicious use of available resources. Health budget should earmark and judiciously utilize the capital project fund in procuring essential equipment and consumables for health facilities, life support equipment like ventilators and multi-parameter monitors.

The establishment of ICU Registries in LMICs will also be a good way of preparing for the inevitable. This will enable the countries to generate fast and reliable data which may help researchers in profiling the Post COVID-19 challenge and also serve as a repository of data that can be shared for knowledge among other relevant stakeholders. Presently in Africa, only two ICU Registries have been established, in Uganda and Kenya, while a third one is about to be activated in Nigeria.³⁰

Continued in-service training of critical care professionals in LMICs cannot be over-emphasized. The new Essential Emergency Critical Care training modules is fast gaining ground and well-suited for developing countries, to fast-track and retain qualitative critical care manpower. This will ensure an “expandable” ICU staffing pool. Although untrained or non-ICU physicians and nurses can be used to expand the staffing pool in critical care settings during emergencies, a cursory look must

be undertaken with respect to the medico-legal implications of this in the particular country, during an un-envisaged emergency situation.

Conclusion

The advent of COVID-19 pandemic went a long way to showcase the unpreparedness and inefficiencies in critical care patients' management in most countries, including LMICs. One of the outcomes of the containment of the SARS-CoV-2 challenge is the new-normal life in most countries and the fact that we could still have another pandemic as a result of "Pathogen X" or in fact a bioterrorism effect as a result of the high global terrorism index. Critical care management of any

Post COVID-19 phenomenon in LMICs will leverage on the lessons learnt in the course of the recent SARS-CoV-2 virus pandemic and a systems approach to its management will go a long way in ensuring the preparedness to contain such new pandemic.

Conflicts of Interest

The authors have no conflicts of interest to declare.

Acknowledgement

We thank Dr. LM Smith, Chair of the Editorial Committee of Medical Research Archives for inviting us to contribute this manuscript.

References

1. Jin Y, Yang H, Ji W et al. Virology, epidemiology, pathogenesis and control of COVID-19. *Viruses*; 2020;12(4): 372
2. Wang L, Wang Y, Ye D, Liu Q. Review of the 2019 novel coronavirus (SARS-CoV-2) based on current evidence. *Int J of Antimicrobial Agents*. 2020;55(6): Article ID. 105948
3. Mannan KA, Farhana KM. Knowledge, attitude and acceptance of a COVID-19 vaccine: a global cross-sectional study. *Int Res J Business and Soc Sc* 2020;6(4):1-23 doi.org/10.2139/ssrn.3763373
4. Ogunbiyi OA. The disproportionate burden of COVID-19 in Africa. In: COVID-19 Pandemic: Lessons From The Frontline. Elsevier 2022: 179-187
5. Abayomi A, Osibogun A, [...], Ogunbiyi S et al. Morbidity and mortality outcomes of COVID-19 patients with and without hypertension in Lagos, Nigeria: a retrospective cohort study. *Global Health Res and Policy*. 2021: 6:26-33
6. Borriello A, Master D, Pellegrini A, Rose JM. Preferences for a COVID-19 vaccine in Australia. *Vaccine* 2021; 39(3): 473-479
7. Ataguba JE. COVID-19 pandemic, a war to be won: Understanding its economic implications for Africa. *Applied Health Economics and Health Policy*. 2020; 18(3): 325-328
8. WHO Coronavirus (COVID-19) Dashboard. Accessed 10 February 2023
9. Nigeria Centre for Disease Control (NCDC) COVID-19 Nigeria. Available at <https://COVID-19.ncdc.gov.ng/report/> Accessed 10 February 2023
10. Ogunbiyi OA, Sanusi AA, Osinaike BB, et al. An overview of intensive care unit services in Nigeria. *J Crit Care* 2021; 66: 160-165
11. Recovery Collaborative Group, Horby P, Lim WS, et al. Dexamethasone in hospitalized patients with COVID-19. *N. Engl J Med* 2021; 384(8): 693-704
12. Drancourt M, Raoult D. Molecular history of plague. *Clin Microbiol Infect* 2016;22(11): 911-915
13. Nnaji CT, Okoli CE. The evaluation of Anaesthesia workforce capacity: An index of safe peri-operative care in the South-Eastern Nigeria. *J Anesth Clin Res* 2023; 14:1096 doi:10.35248/2155-6148.23.14.1096
14. Asingei J, O'Flynn EP, O Donovan DT. The Specialist Anesthesiology Workforce in East, Central and Southern Africa. *Anesth Analg* 2023; 136 (2): 230-237
15. United Nations Economic Commission For Africa (UNECA). <https://health.economictimes.indiatimes.com/news/industry/virus-exposes-gaping-holes-in-Africa-healthsystems/75599490>. Accessed 25th February 2023
16. Kwizera A, Denser M, Nakibuuka. National intensive care unit bed capacity and ICU patient characteristics in a low-income country. *BMC Res Notes* 2012;5:475 doi 10.1186/1756 – 0500-5-475
17. Biccard B, Baker T, Mabedi D, Waweru-Siika W. The state of critical care provision in low-resource environments. *Anesthesia & Analgesia* 2022;134(5):926-929
18. Siaw-Frimpong M, Touray S, Sefa N. Capacity of intensity care units in Ghana. *J. Crit Care* 2021;61:76-81
19. Murthy S, Leligdowicz A, Adhikari NKJ. Intensive care unit capacity in low-income countries: a systematic review. *PLoS One*. 2015;10:e0116949. <https://doi.org/10.1371/journal.pone.0116949>.
20. Kwizera A, Kabatooro D, Atumanya P, et al. Respiratory support techniques for COVID-19-related ARDS in a sub-Saharan African country: A multi-center observational study. *CHEST* 2023; doi: <https://doi.org/10.1016/j.chest.2023.01.039>
21. Dundorp AM, Iyer SS, Schitz MJ. Critical care in resource-restricted settings. *JAMA* 2016;315:753-4. doi: 10.1001/jama.2016.0976
22. Beane A, Padeniya A, De-Silva AP et al. Closing the theory-to-practice gap for newly qualified doctors: Evaluation of a peer-delivered practical skills training course for newly qualified doctors in preparation for clinical practice. *Postgrad Med J* 2017;93:592-6
23. Buowari DY, Owoo C, Gupta L, et al. Essential Emergency and Critical Care: A priority for health systems globally. *Crit Care Clin* 2022;38(4):639-656
24. Dan-Nwafor C, Ochu CL, Elimian K, et al. Nigeria's public health response to the COVID-19 pandemic: January to May 2020. *J Glob Health* 2020;10(2):020399 doi:10.7189/jogl;10.020399
25. Ilesanmi OS, Fagbule OF. Realities of COVID-19 pandemic in Nigeria: Coping with the challenges and charting a way forward. *Ann Ibd Pg Med* 2020;18(1):78-84
26. Liu Q, Luo D, Haase JE, et al. The experiences of healthcare providers during the COVID-19

- crisis: A qualitative study. *The Lancet Global Health* 2020;8:e790-798
27. Jee Y. WHO International Health Regulations Emergency Committee for the COVID-19 outbreak. *Epidemiol Health* 2020;42:e2020013 doi: 10.4178/epid.e2020013
28. WHO to study Madagascar's drug to treat COVID-19. Available at <https://www.aa.com.tr/en/africa>. Accessed 28 May 2020.
29. Mousavi M, Ahmadi N, Ghaheh HS, et al. Psychological impact of COVID-19 on health-care workers: A multicenter cross-sectional study. *J. Res Med Sci* 2021:77-82
30. Nigeria Critical Care Registry: Collaboration Between the Intensive and Critical Care Society of Nigeria and the Critical Care Asia and Africa Network. 2022