Title: COVID-19 Perspectives in Low- and Middle-Income Countries

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Abstract

COVID-19 is a new highly infectious disease with an incompletely described clinical course, which has caused a pandemic, with Europe being identified as the third epicentre. COVID-19 has placed unprecedented pressure on critical care services which is likely to stretch resources beyond capacity. The situation is exacerbated by increased staff absence from self-isolation and illness, increased referral of patients with suspected or confirmed COVID-19 who develop respiratory failure, and limited availability of Extra Corporeal Membrane Oxygenation (ECMO) services. In addition, there is the ongoing challenge of patients being transferred between departments and hospitals for ongoing care. In consequence, as current needs continue to rise, innovative approaches are needed to redress shortages and support the continuance of services. This article provides an overview of severe COVID-19 infection, outlining treatment strategies and nursing processes that will need to develop and extend in response to this evolving situation.

Key words

SARS-CoV2, 2019-nCOV, COVID-19, Critical Care, Pandemic, ARDS

Key references

Hopman J. Allegranzi B. Mehtar S. (2020). Managing COVID-19 in Low- and Middle-Income Countries. JAMA. Viewpoint. 16 March 2020.

Kyriacos U. Jelsma J. James M. Jordan S. (2014). Monitoring Vital Signs: Development of a Modified Early Warning Scoring (Mews) System for General Wards in a Developing Country. PLoS One. 2014; 9. 1. e87073. DOI 10.1371/journal.pone.0087073

Rajagopal MR. Smith R. (2020). The arrival of covid-19 in low and middle-income countries should promote training in palliative care. BMJ opinion. www.blogs.bmj.com

In many low to low-middle income countries critical care services have evolved and developed relatively recently as advances in medicine have changed and enhanced the possibilities for treatment, increasing the numbers of patients needing intensive care. The nature of the current pandemic has implications for critical care nursing in all countries, as in severe COVID-19 disease, an estimated 5% of patients requiring invasive ventilation and admission to intensive care, with a further 14% requiring oxygen therapy (Wu et al., 2020) [1]. For resource limited countries this is a major cause for concern, as responding to rapidly increasing patient need in settings with a critical shortage of intensive care beds and specialist staff, is extremely difficult. As a result, mortality due to COVID-19 may be higher than the predicted case fatality rate, and it is also debatable for how long low- and middle-income countries would be able to fund the additional care costs critical care from their limited budgets [2].

As critical care is a complex, rapidly evolving and developing speciality [3], nurses need to have additional education and training to gain the specialist knowledge, skills and expertise needed. In many High-Income Countries (HIC) education and training programmes are limited, but in many low- and middle-income countries (LIC/LMIC) the problem is exacerbated by the lack of appropriate courses, and a major shortage of trained and experienced critical care staff. In addition, most training programmes have been developed in HICs with little regard for the very different healthcare systems, setting and facilities their colleagues in LMICs work within [4]. Challenges in utilising processes from another context are compounded because evidence regarding effectiveness and efficiency of care processes is likely to come from HICs with little recognition that limited access to critical care (for invasive ventilation or non-invasive ventilation) could pose a significant and potentially catastrophic challenge to services. There remains an urgent need for COVID-19 related research, policy and guidelines appropriate for resource limited settings and differing health care systems, with a priority on public health and prevention strategies. As a result, this article focuses on some of the issues that need consideration when managing a suspected or confirmed COVID-19 patient in a resource limited setting.

In many LIC and LMIC, most hospitals are in cities, while the majority of the population live in rural areas, making access to appropriate healthcare, and assessment of actual need, difficult. Patients tend to present late in the disease trajectory than in HICs, in part because

financial hardship can compound the problem of access. Even as countries work to improve access to hospital and critical care, it is likely that their healthcare systems will struggle to contain pandemics such as COVID-19, where rapid patient deterioration means that any delay adversely impacts on chances of recovery. In a COVID-19 type outbreak, issues such as enforced local travel restrictions and loss of work add to the problems, with patients struggling to access hospital services at all, or presenting too late. Unprecedented rises in numbers of patients urgently requiring critical care could overwhelm already overstretched services and staff. In consequence, in planning for future services there may be a need to scale up rural healthcare clinics and hospital outreach services including critical care and expand healthcare service provision in rural areas with high resident populations.

For instance, in India, there are an estimated 30-50,000 ventilators available for the estimated 1 million people, that disease projections suggest are likely to require ventilation at the peak of a COVID-19 outbreak [5]. This situation fits with other LMICs where evidence also reveals a high burden of critical illness on wards and limited availability of critical care beds. In Zambia, Dart et al's (2017) [6] audit exploring adult medical and surgical ward patients in a tertiary referral hospital, found 45% of patients had objective evidence of need for admission to critical care, yet few had been admitted. From this data, the researchers hypothesised that for the hospital which reported 17,496 annual acute admissions, this equated to 7,873 patients requiring critical care input. However, they found there were only 8 critical care beds for the whole hospital, findings that were confirmedby the internal audit of Zambia's critical care services which revealed a total of 70 beds across the whole country [7]. These two examples give an indication of the scale of additional resources required to provide comprehensive, sustainable, critical care services. The corollary from this, is that inevitably the majority of critically ill patients are nursed on general wards, managed by ward nurses and doctors with limited, or no, critical care training. There is concern that healthcare services would struggle to cope with acute exacerbations and/or patient deterioration when they have little or no way to escalate care provision at short notice [6, 8, 9]. This affirms the need for context specific healthcare policy and service provision, with an emphasis on public health and preventing spread of the disease amongst communities.

There is a second and major clinical issue, the very nature of a pandemic means that health care professionals have to protect themselves and their colleagues as they strive to care for

patients, with what may well be an unfamiliar, and little understood disease. The current pandemic has shown that few HICs can afford to stockpile personal protective equipment (PPE) and the situation in LMICs is likely to be no better. Indeed, they have the added problem of not having rapid access to increased resources to facilitate acquisition of adequate, appropriate PPE. There is sufficient evidence of the impact of insufficient PPE on healthcare staff, with its inevitable accompaniment of loss of some healthcare workers [10]. This is tragic in any circumstances, but in resource limited settings, the loss can have an additional short- and long-term impacts on healthcare services. Prior to the Ebola outbreak in Sierra Leone in 2014, there were just 70 surgeons and 68 nurse specialists providing care to 5.8 million people through 23 public hospitals [11]. Following the outbreak, the number of healthcare workers reduced, because they either fled, died, or could not work, in some instances because of fear, but in others they were caring for loved ones. While the immediate outbreak was contained and managed, the long-term recovery from this disaster is taking years, hampered by the void left by the loss of experienced healthcare workers [12]. During a pandemic, such as the COVID-19 outbreak, there is a risk that much of the workforce may be unable to come to work due to symptoms, co-morbidities, or self-isolation following contact with infected patients. However, it has to be accepted that in societies where there is financial hardship there is the risk that low paid staff may need to continue to work when they have been exposed to, or have symptoms indicating they are developing the disease.

Nevertheless, resource limited environments do have a few advantages, in many such settings, the re-use of the single-use items may be a routine necessity for providing lifesaving care. They are still using strategies that HICs have long abandoned and are now having to re-invent and re-introduce as demand repeatedly exceeds supply. These accepted routine protocols may well need adjusting as with COVID-19 or other such new viral diseases, the length of time the virus can remain live on surfaces and equipment may not be known. Then too, incorrect decontamination or sterilisation of equipment may result in iatrogenic spread of the disease [13]. Also many of these countries have had experience of managing national and international infectious disease outbreaks, because they regularly face infectious disease outbreaks such as measles, polio and cholera, and as result are prepared for mass public health messaging, which may prevent the spread of outbreaks and pandemics such as COVID-19, allowing for preparedness and scale of healthcare systems.

For example, in 2003, Viet Nam was the first country to successfully control the spread of Severe Acute Respiratory Syndrome (SARS) [14]. In 2015, the containment of Ebola in West Africa, prevented a global spread.

Following their control of SARS, Viet Nam carefully documented the progress of the disease and the policies to manage it and then focused on preparing for any such future pandemics. They have a significant shortage of healthcare professionals with an estimated 8 doctors and 1.432 nurses per 1,000 people [15]. As a result, their policies had to be designed to mobilise an integrated, comprehensive response with acute, community and preventative healthcare services acting together as one united workforce. Their approach was successfully tested this year when they were able to implement their policies from the moment the first case was diagnosed in January 2020 and in total 300 cases and no deaths [16]. The case study from Viet Nam (below) illustrates the importance of government, regional and local preparation and mobilisation policies and guidelines; were stringent but accepted and followed by the whole country. The difference in their outcomes with its lack of fatalities to those of Europe and the USA demonstrate that finance aloneis not sufficient to control a pandemic [17]. Viet Nam, because of their past experiences, moved decisively, containing those infected, then testing individuals and contacts early. In recognition of the importance of such rapid action the WHO Africa Region has been working across the continent to enable countries to scale their readiness for pandemics such as COVID-19. Due to their support, at the start of the pandemic, only two countries could test for COVID-19, but now 44 countries have the testing kits for COVID-19 [18]. By April 2020, the most affected countries were South Africa, Algeria, Cameroon, Ghana, Cote d'Ivoire and Guinea [19], but none of these have seen the deaths as seen in HIC as cited above.

The examples of success from rapid response to the recent pandemic, even with limited finance has confirmed the need for countries to be adequately prepared. The challenge of lack of PPE, is twofold for countries with limited resources to store PPE is extremely difficult as it means restricting finances from other services. Also, no one could have anticipated the speed at which PPE was used and/or became contaminated. The modern approach of single use PPE inevitably led to a dearth of equipment, and alternative strategies need to be developed [20]. One practical way that LMICscould adopt is to make their own washable (boilable) scrubs, gowns, masks and hats. There are now websites where patterns can be downloaded that are easy to follow that result in durable clothing that can be used

repeatedly. There is also the fact that an unusualelement of COVID-19 is the need for total facial protection because facial visors are expensive. However, it is possible for countries to follow the example of the UK, where volunteers were mobilised to make visors for use in hospitals andcommunities again plans can be downloaded from the internet. Finally, of equal importance to PPE is hand hygiene, and for countries where running water is not always available, the WHO (2010) [21] have approved a formula for developing alcohol hand gel.

Confirming diagnosis can also be problematic, given the geographical spread of healthcare services in many LMICs, access to laboratories able to process samples may be limited, therefore in the absence of testing, triage based on clinical case definition or presumptive diagnosis can be used[2]. It is essential that countries work together, sharing information as early as they can to allow for diagnostic indicators of new diseases to be developed and shared. Patients thought to be infected may initially be cohorted in ward areas, although strict isolation must be followed, either using separate rooms or maintaining a minimum 2 metres between beds. These approaches are challenging as additional staff will be required to observe side wards and to work on additional wards if they need to be opened. Recognition of the deteriorating patient may be difficult due to lack of knowledge of the disease trajectory, reduced staff on wards and limited availability of equipment. Nursing and medical students may need to be deployed to ward areas and depending on the numbers, to supervise a group of patients and perform vital signs. In these circumstances, it is essential that all observation charts are clear and easy to complete. For example, observations charts may incorporate an early warning scoring (EWS) tool based around core vital signs (heart rate, systolic blood pressure, respiratory rate, temperature and conscious level) [22-23]. Protocols and guidelines need to clearly state that in instances such as severe COVID-19 disease, patients may rapidly deteriorate, and EWS are unlikely to be sensitive enough, as the presenting symptoms mean that these patients will all score highly. In consequence, nurses will need to recognise that every contact counts, they must record vital signs but also look for additional signs and symptoms and record and report any changes in the patients' status.

Observations and any trends they reveal need to be carefully studied to identify patients who require escalation in care [24]. For example, patients who show signs and symptoms of increasing respiratory difficulty should be identified and moved to areas within the wards

where increased observation and access to oxygen and emergency suction is available. These areas allow for greater observation and may have additional resources such as oxygen and suction to help maintain oxygenation and reduce further respiratory failure [8].

Access to oxygen is likely to be an issue, throughout the hospital system. Ideally, an oxygen plant should supply the hospital, but either may not be adequate, or may be absent. Therefore, various oxygen sources including walled, cylinder oxygen and oxygen concentrators may need to be used. In most countries, the onset of a pandemic leads to a reduction in planned and elective surgery and this may facilitate access to additional oxygen sources. However, in many LMICs, hospitals deal with more emergency than elective surgical cases and in these instances access to oxygen is likely to be an increasingly challenging. All healthcare workers need to recognise the importance of conserving oxygen supplies, for example, switching off oxygen sources, when not in use [25].

It has always been recognised that the prone position allows for improved ventilation/perfusion (VQ) matching and reduced hypoxeamia, recruitment of the posterior lung segments due to the reversal of atelectasis and improved secretion clearance [26]. However, pandemics such as COVID-19 make healthcare professionals review their practice, as a result, it has been recognised that patients benefit from being placed in the prone position while still conscious. The indications for the conscious prone position include an oxygen requirement of greater than 28% to maintain a Sa02 92-96% (88-92% if risk of hypercapnic respiratory failure) and suspected or confirmed COVID-19 [26]. An added advantage for this is it is requiring little equipment and therefore can be utilised for a high percentage of patients while on wards [26].

Nevertheless, all healthcare workers need to check for contra-indications such as respiratory distress (tachypnoea respiratory rate >35/min, PaC02 $\geq$6.5 and use of accessory muscles, immediate requirement for intubation, haemodynamic instability, reduced level of consciousness or agitation and unstable spine, thoracic injury or recent abdominal surgery. Relative contraindications that also need consideration include facial injuries, neurological disorders, morbid obesity, second or third trimester of pregnancy and pressure sores / ulcers [26].

The patient should be assisted into the prone position, additional pillows mayneed to be used to support the chest, a reverse Trendelenburg position may aid comfort, but sedation should not be used to facilitate or maintain proning. Once in the prone position, oxygen

saturations should be recorded for 15 minutes, vital signs (and EWS) and the patient re-assessed. If the oxygenation improves (Sa02 92-96% (88-92% if risk of hypercapnia) and there are no signs of distress, the patient should remain in the prone position for 1-2 hours or as long as can be tolerated. The patient should then be returned to the supine position and nursed upright between 30-60°, oxygen should be titrated as indicated. If the patient does not respond to this, the nurse should check the oxygen isnot disconnected or kinked, and/or if using an oxygen cylinder, it is not due to run out. The oxygen should be increased, and the patients' position changed including side lying. The position should be discontinued if there is no improvement with the change of position, the patient unable to tolerate the position and/or there is severe tachypnoea (respiratory rate 35), the patient is looking tired or there is use of accessory muscles [24, 26]. In these circumstances the patient should be returned to the supine position and care escalated into critical care.

In all circumstances, including resource limited settings, the decision to intubate should only be made if a critical care bed is available, and sufficient staffing and equipment. The use of anaesthetic machines may provide a few additional machines. The type of ventilator used will determine the type of ventilation strategy used, but these should include lung protection strategies and all ventilated patients should be monitored. Monitoring will be dependent of the resources available, but as a minimum should include continuous cardiac monitoring and pulse oximetry. Availability of closed suction catheters and viral filters for ventilators may be limited, in consequence, critical care areas are likely to be high risk areas due to the aerosolization and requirement to disconnect patients from ventilators to suction [27]. To reduce the risk, every effort should be made to improve air flow, for example, opening windows if possible.

It is accepted that severe COVID-19 disease may result in the development of acute respiratory distress syndrome (ARDS). However, identifying and applying the internationally agreed ARDS definition in a resource limited setting may be difficult due to limited availability of resources [28]. In these situations, it may be appropriate to use the Kigali modified ARDSdefinition and criteria. This includes recording any new clinical insult or new or worsening respiratory deterioration within one week, SpO2/FiO2 <315, no Positive End Expiratory Pressure (PEEP) requirement consistent with American European Consensus Conference Definition. Chest X-ray or ultrasound shows bilateral opacities not fully explained by effusions, lobar/lung collapse or nodules and respiratory failure not fully explained by

cardiac failure or fluid overload [28].

As with conscious patients, the prone position should be used in ventilated patients. However, it has to be noted, that it needs more staff to reposition the patient and extra resources to manage a patient with severe hypoxaemia. To reduce the risk of aspiration bolus enteral feeding should be avoided while the patient is in the prone position and gastric aspirates should be measured every 4-6 hours.

Complications that may arise as the disease trajectory progresses include renal failure [29]; current evidence suggests that the level of acute kidney failure may be as high as 50% [30], with an estimated 20-35% requiring renal replacement therapy (RRT) [31]. In hospitals with access to RRT, a system of sharing machines may need to be used. However, this has an increased cost element as there is an increased used of consumables and there is an increased risk of intragenic anaemia due to blood loss from repetitive circuit changes. With limited access to RRT machines other methods of renal support including peritoneal dialysis may need to be used. Acute peritoneal dialysis is indicated in patients who have not had previous major abdominal surgery, stable ventilation and cardiovascular, haemoglobin >70g/L, activated partial thromboplastin time ratio(APTTR)<1.3, International Normalised Ratio (INR)<1.3 and Platelets >60x10^9/L. There are two types of PD catheters, either a rigid or flexible catheter [32]. Once the catheter is inserted into the patient's abdomen the peritoneal membrane is used as a filter to remove excess waste and water. Dialysis fluid is then drained into the abdomen and then back out. Contra-indications include a body mass index >35, abdominal distension due to constipation and known abdominal aortic aneurysm [30]. The advantages to using PD include lower cost, less consumables required, minimal infrastructure and power, less requirement of highly trained renal staff, releasing them to undertake supervisory and mentoring roles and run continuous RRT machines and is a lifesaving intervention [32]. Disadvantages include using large volumes may impair diaphragmatic movement and may affect ventilation, particularly if the patient requires non-invasive or invasive ventilation.

As the above indicates, training of all staff especially those re-deployed is essential, to respond to the increasing complex needs of patients and demands. Training must include the role of prevention, the need for protection of healthcare workers, together with an understanding of the disease progression, escalation options and palliation [33]. Relativelyhigh numbers of patients who are likely to die, in a context where palliative care

possibilities are limited. Therefore, staff must have preparation and training in controlling symptoms in dying patients, including pain, breathlessness, delirium, agitation and end of life care, breaking bad news and access to opioid medicines [34]. It is important to remember the impact of these increasing deaths may have on healthcare workers and strategies to support mental health and wellbeing need to be included in all training programmes. Resources and support could be drawn from staff used to dealing with HIV/AIDS and cancer care. Psychological first aid (PFA) is a tool developed by the WHO to support people after a crisis event. PFA is not professional counselling or psychological debriefing or analysing what happened. The model involves peers listening to people's stories, being safe, connected to others, calm and hopeful, support and regaining a sense of control [35].

In all pandemics and outbreaks, not least COVID-19, lockdowns and international flights restrictionare one of the main challenges for the deployment of experts to support national responses [19], although increased access to technology such as Zoom, Skype and Microsoft Teams has enabled countries to share good practice and to develop new initiatives. With the international travel restrictions and the economic impact of COVID-19, experts, volunteers and immediate donor funding may be restricted (19, 2]. This is not a new, for example, during the Ebola outbreak in West Africa in 2014, identified as a large scale, gradual onset natural disaster; initially, the political and international response was slow [35]. In consequence, the lessons learnt has identified healthcare systems and nurses need to continue to provide care in an already stretched healthcare system, while awaiting additional international help and support. However, it could be argued that recent outbreaks in low- and middle-income countries has meant healthcare systems and personnel are more prepared to respond, but this does not negate the importance of the international co-operation and support.

Conclusion

In this article, perspectives in the management of severe COVID-19 disease in a resource limited setting has been explored. In relatively short periods of time, healthcare systems have had to re-organise to prevent the transmission and slow the rate of new infections, for low- and middle-income countries whose healthcare systems are already overstretched this requires a different approach. Care of patients with severe COVID-19 disease must have an evidence base and this must be appropriate for the context in which care will be provided.

Therefore, parallel development of evidence-based care from both low- and high-income settings must be developed, with sharing of evidence and lessons learnt.

CASE STUDY: COVID-19 outbreak, Hanoi, Viet Nam

In mid-March at alarge hospital in Hanoi was confirmed3-4 inpatient and ancillary departments identified 43 cases of COVID-19. The positive COVID-19 tests included healthcare workers, patients, relatives and catering employees, and cases in the community due to each exposure.

The Hospital was "locked down" to localize the epidemic. The hospital hadapproximately 800 severely ill patients who could not be discharged or referred to lower levels of care. There were over 500patients with end-stage renal failure who needed dialysis and more than 700 patient family members and 1300 medical staff on duty. The lock-down was for 14 days and implemented by hospital management. Healthcare workers were isolated between shifts in government designated seclusion accommodation. After three days, the Hospital was permitted to admit seriously ill patients, and patients needing urgent dialysis were escorted in one by one and then isolated at home. After 14 days re-testing was carried out and as no further new cases of COVID-19 were found, staff were allowed to return home and normal services from the hospital resumed.

At the same time, the Ministry of Health (MOH) asked the provincial health services to investigate and review all individuals who had attendedHospital in the 14 days before lockdown. They were given four days to do this. In that time all residential areas were tasked with identifying and interviewing all hospital contacts from the identified period. The total number of those screened and managed was 44,293 people. This included 4,736 inpatients, 1,272 outpatients, 30,515 registered outpatients, 7,026 relatives/caregivers, 91 caterers and 653 others involved. Inevitably most contacts had come from residential areas from within Hanoi (16,714 contacts). Prior to releasing lockdown, approximately 2,500 healthcare workers were re-tested for SARS-CoV-2.

A senior MOH advisor reported the COVID-19 outbreak at Bach Mai had included the greatest number of cases nationwide, but the outbreak had been controlled because:

- Firstly, the Hospital was closed to new admissions andlocked-down, implementing epidemic intervention measures which included isolating all health workers, patients, patients' families, service providers and deep cleaning of the hospital.
- Second, all healthcare workers, patients, family members, service providers were tested. The results showed that all healthcare workers were negative for SARS-CoV-2, but a number of positive results were obtained, most of these were employees contacted to the hospital.
- Thirdly, the residential localities succeeded in screened everyone who had attended the Hospital in the 14 days prior to lock-down. This had been led by the MoHand

Provincial Senior Health professionals. Following completion of the investigation and screening the community localities continued to manage and monitor identified individuals.

Results

COVID-19 is highly contagious, and as healthcare workers, catering staff, patients and relatives move around the hospital they could spread the disease. It was difficult to identify the first case (F0), but from the total 43 cases, 27 were from the catering company and there was some spread into the community. Those in close contact were placed in isolation for health monitoring, for example one patient, this meant her husband, another son, her mother and the maids were all placed in isolation for monitoring.

In addition, to the 44,293 people tested a dedicated phone number was released requesting anyone who had not been screened but had attended the Hospital to make contact for testing. During lockdown all hospital services were suspended but bodies were still released for funerals. Regulations state each funeral in an epidemics/pandemic should not have more than 20 mourners.

Conclusion

This case study is a clear example successful intervention from a country prepared for unknown and unprecedented infectious outbreaks. It demonstrates the importance of an integrated and coherent policy with guidelines for practice. It affirms the points made previously it is not finance alone that is essential but co-operation, knowledge exchange sharing across disciplines and between acute and community sectors. There are lessons for other nations and for planning for future infectious disease outbreaks.

References

1. Wu Z. McGoogan JM. (2020). Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China. JAMA. doi:10.1001/jama.2020.2648

2. Hopman J. Allegranzi B. Mehtar S. (2020). Managing COVID-19 in Low- and Middle-Income Countries. JAMA Viewpoint. 16 March 2020.

3. Endacott R. Jones C. Bloomer MJ et al. (2015). The state of critical care nursing education in Europe: an international survey. Intensive Care Med. DOI 10.1007/s00134-015-4072-y

4. Carter C. Mukonka P. Wanless S et al. (2018). Critical care nursing in Zambia: global healthcare integration. British Journal of Nursing. 27. 9. 497-498

5. Centre for Disease Dynamics, Economics and Policy. (2020). Modelling the Spread and Prevention of COVID-19. https://cddep.org/covid-19/

6. Dart PJ. Kinnear J. Bould MD et al. (2017). An evaluation of inpatient morbidity and critical care provision in Zambia. Anaesthesia. 72. 172-180

7. Zambian Ministry of Health. (2016). Critical Care Nursing National Needs Assessment. In conjunction with Birmingham City University (UK). Zambia.

8. Carter C. Snell D. (2016). Nursing the critically ill surgical patient in Zambia. British Journal of Nursing. 25. 20. 1123-1128

9. Lillie EMMA. Homes CJ. ODonohue EA. Bowen L. Ngwisha CLT. Ahmed Y. Snell DM. Kinnear JA. Bould MD. (2015). Avoidable perioperative mortality at the University Teaching Hospital, Lusaka, Zambia: a retrospective cohort study. Canadian Journal of Anaesthesia. 62. 1259-67

10. World Health Organization. (2020). Rational use of personal protective equipment for coronavirus disease 2019 (COVID-19). www.who.int

11. Brown C. Arkell P. Rokadiya S. (2015). Ebola virus disease: the 'Black Swan' in West Africa. Tropical Doctor. 45. 1. 2-5

12. Holmer H. Lantz A. Kunjumen T. Finlayson S. Hoyler M. Siyam A. Montenegro H. Kelley ET. Campbell J. Cherian MN.Hagander.(2015). Global distribution of surgeons, anaesthesiologists, and obstetricians. DOI: http://dx.doi.org/10.1016/S2214-109X(14)70349-3

13. Iserson KV. (2016). Improvised medicine: providing care in extreme environments.

2nd Edition. McGraw Hill Education

14. Vu HT. Leitmeyer KC. Le DH. Megge JM. Nguyen QH. Uyeki TM. Reynolds MG. Aagesen J. Nicholson KG. Vu QH. Bach HA. Plant AJ. (2004). Clinical Description of a Completed Outbreak of SARS in Vietnam, February–May 2003. Emerg Infect Dis. 10. 2. 334–338.

15. World Bank. (2020). Nurses and Midwives per 1000, Vietnam. https://data.worldbank.org/indicator/SH.MED.NUMW.P3?locations=VN

16. Channel News Asia. (2020). After aggressive mass testing, Vietnam says it contains COVID-19 outbreak. 30 Apr 20. www.channelnewsasia.com

17. Centre of Disease Control and Prevention. (2020). Cases in the UK. https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/cases-in-us.html

18. World Health Organization. (2020). African countries move from COVID-19 readiness to response as many confirm cases. https://www.afro.who.int/health-topics/coronavirus-covid-19

19. World Health Organization. (2020). COVID-19 situation updates for the WHO African Region. 22 April. External Situation Report 8.

20. Thomas.net. (2020). How to Make Protective Gowns for Coronavirus/COVID-19. https://www.thomasnet.com/articles/other/how-to-make-protective-gowns-for-coronavirus-covid-19/

21. World Health Organization. (2020). Alcohol-based Handrub Formulation & Production. www.who.int

22. Krysta 1. Kyriacos U. Jelsma J. James M. Jordan S. (2014). Monitoring Vital Signs: Development of a Modified Early Warning Scoring (Mews) System for General Wards in a Developing Country. PLoS One. 2014; 9. 1. e87073. DOI 10.1371/journal.pone.0087073

23. Kyriacos U. Jelsma J. James M. Jordan S. (2015). Early warning scoring systems versus standard observations charts for wards in South Africa: a cluster randomized controlled trial. Trials. 20. 16. 103. DOI: 10.1186/s13063-015-0624-2.

24. Carter C. Aedy H. Notter J. (2020). COVID-19 Disease: Assessment of a Critically Ill Patient. In press assessment

25. NHS England. (2020). Clinical guide for the management of critical care patients during the coronavirus pandemic. 16 March 2020. Version 1.

26. Intensive Care Society. (2020). Guidance for conscious proning. www.ics.ac.uk

27. Public Health England. (2020). Guidance: Transmission characteristics and principles of infection prevention and control. 3 April 2020. www.gov.uk

28. Riviello ED. Kiviri W. Twagirumugabe T. Mueller A. Banner-Goodspeed VM. Officer L, Novack V. Mutumwinka M. Talmor DS. Fowler RA. (2020). Hospital Incidence and Outcomes of the Acute Respiratory Distress Syndrome Using the Kigali Modification of the Berlin Definition. Am J Respir Crit Care Med. 193. 1. 52-9. doi: 10.1164/rccm.201503-0584OC.

29. EMRIT. (2020). Internet Book of Critical Care. https://emcrit.org/ibcc/COVID19/#renal_failure

30. Bowes E. (2020). King's Kidney Care King's College Hospital NHS Foundation Trust Acute Peritoneal Dialysis on Intensive Care Units protocol 17th April 2020. London.

31. Intensive Care Society. (2020). COVID-19: a synthesis of clinical experience in UK intensive care settings. London

32. Georgi Abraham G. Varughese S. Mathew, M. Vijayan M. (2015). A review of acute and chronic peritoneal dialysis in developing countries. Clin Kidney J. 8. 3. 310–317

33. Christian R Ntizimira CR. Nkurikiyimfura JL. Mukeshimana O. Ngizwenayo S. Mukasahaha D. Clancy C. (2014). Palliative care in Africa: a global challenge. Ecancermedicalscience. 8, 493.

34. Rajagopal MR. Smith R. (2020). The arrival of covid-19 in low and middle-income countries should promote training in palliative care. BMJ opinion. www.blogs.bmj.com

35. World Health Organization. (2020). Psychological first aid. https://www.who.int/publications-detail/psychological-first-aid

36. Shepherd-Barron J. (2015). Ebola: most unnatural disaster. The Lancet Global Health Blog. http://globalhealth.thelancet.com/2015/03/24/ebola-most-unnatural-disasters