



ORIGINAL ARTICLE

Restoring non-COVID-19 clinical research and surveillance in Oyo state, Nigeria during the SARS-CoV-2 pandemic

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Abstract

Background: Many sub-Saharan African patients receive clinical care from extramurally-supported research and surveillance. During the COVID-19 pandemic, pausing these activities reduces patient care, surveillance, and research staff employment, increasing pandemic losses. In Oyo State, Nigeria, we paused a multi-country invasive salmonellosis surveillance initiative and a rural clinical bacteriology project.

Objective: Working with research partners raises health facility concerns about SARS-CoV-2 transmission risks and incurs infection prevention costs, so we developed and implemented re-opening plans to protect staff and patients and help health facilities deliver care.

Methods: Our reopening plan included appointing safety and personal protective equipment (PPE) managers from existing project staff cadres, writing new standard operating procedures, implementing extensive assessed training, COVID-19 testing for staff, procuring and managing PPE, and providing secondary bacteraemia blood culture support for COVID-19 patients in State isolation facilities.

Results: Surveillance data showed that the pandemic reduced care access and negatively affected patient unsupervised antibacterial use. The re-opening plan repurposed human and material resources from national and international extramurally-supported programs to mitigate these effects on public health.

Conclusions: A structured reopening plan restarted care, surveillance, and infection prevention and control.

Keywords: Essential services, Blood culture, COVID-19, Surveillance

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INTRODUCTION

Infectious disease outbreaks can be disruptive to health care (1). Among other things, the COVID-19 pandemic has interrupted HIV and tuberculosis diagnosis and care, blocked access to essential maternal and child health programs, grossly curtailed access to surgery and threatened global polio eradication (2-5). The World Health Organization (WHO) has emphasized the need to keep basic health services running during the pandemic (6) and there is a pressing need for best-practice templates for restoring essential services in resource-limited settings, without placing clients and health care delivery staff at risk (7). Additionally, COVID-19 infections may occur in individuals with other infections and/or predispose patients to common endemic diseases (8). Therefore, mutually supporting systems for COVID-19 and endemic infection care need to be established or reopened.

We perform extramurally-supported bacteraemia research and surveillance in collaboration with local hospitals and a primary health care centre in Ibadan metropolis, as well as a remote rural facility in nearby Ibarapa Central local government area, both in Oyo State, Nigeria. Our collaboration provides patient-participants with free diagnostics and covers overheads for blood culture and other diagnostics that support care for patients not enrolled in research. All our research and surveillance activities halted early in COVID-19 pandemic because of safety concerns. The potential for research-focused activities to disrupt caregiving in a pandemic must be acknowledged and academics have been critiqued as being ill-suited to mount suitable and effective pandemic responses in at least some settings (9). We describe here steps taken by our research and surveillance teams, in consort with health facilities we work with, and the challenges met and overcome, towards re-opening our services and supporting health care delivery. We also provide data pointing to the importance of ensuring continuity of care in our low-income setting where access to healthcare is difficult and antimicrobial misuse therefore common.

MATERIALS AND METHODS

Training and SOP development

The COVID-19: Effective Nursing in Times of Crises course offered online by John Hopkins University (JHU) on the FutureLearn® platform <https://www.futurelearn.com/courses/effective-nursing-in-times-of-crisis> was taken by the projects' principal investigator and a pandemic safety officer, who was selected for this responsibility from among existing research associates. The course outlines the nursing response to challenges posed in the wake of COVID-19 and provides guidance for facility management in epidemics. Thereafter, the principal investigator, safety officer and two personal protective equipment (PPE) managers undertook training courses on Occupational Safety and Health Administration (OSHA) <https://www.oshatrain.org/courses/mods/709e.html> and Infection Prevention and Control (IPC).

Standard Operating Procedures (SOPs) for operation in a pandemic were written/revised by the safety officer with input from other team members after which it was reviewed and approved by a Consultant Clinical Microbiology co-investigator and the principal investigator. The SOP detailed workplace general requirements, health screening, hygiene at the workplace, and regular cleaning of the offices. It also contains precautionary measures for shared workspaces and common areas, and at entry and exit of office premises. It specified precautions to be taken by each work cadre, including research assistants/associates and research clinicians, phlebotomists, laboratory staff, cleaners and dispatch riders. The SOP also detailed minimum PPE requirements.

Supplementary information The online version of this article ([Tables/Figures](#)) contains supplementary material, which is available to authorized users.

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A protocol was additionally developed in collaboration with Oyo State isolation facility personnel for providing blood culture services to COVID-19 patients with suspected secondary bacteremia, which was sent for ethical review and approval.

After training and protocol development, project staff were invited to a three-hour in-person course with resource persons from the Oyo State COVID-19 Task Force to prepare for the reopening. An in-house test was then administered online and the results demonstrated that additional training was necessary. Reopening was, therefore, put off and staff were required to take a free online Infection, Prevention and Control for COVID-19 course <https://elearning.ncdc.gov.ng/courses/infection-prevention-and-control-for-covid-19/>, which at the time was newly offered by the Nigeria Centre for Disease Control (NCDC), includes assessment and offers certification. It is available free online, with registration. Staff were also required to comply with pandemic training and procedures at individual health facilities at which they worked.

COVID-19 testing

We requested that all frontline staff, and those they would work with directly, be tested for COVID-19 before resumption. Testing was done via the Oyo State COVID-19 Emergency Operation Centre at no charge to the project or staff members, using Nigeria's required RT-PCR protocols at one of the two designated test centres in Oyo State.

Indicators of patient access to care and avoidance of health facilities

The impact of the pandemic on patient access to care after reopening was estimated by comparing August-September 2020 study enrollment numbers for typhoid surveillance in Ibadan to the same months for 2017-2019. August and September are typically low-yield months for invasive *Salmonella*, the primary target of our Ibadan surveillance, but they were chosen because they were the first two full months of our operations after resuming. We estimated antimicrobial pretreatment as an indicator of hospital avoidance by comparing bacteraemia yield and Gram-positive bacteria proportion, both of which are lower in patients who have taken antimicrobials prior to blood culture sample

collection. In addition, the Urotest® kit was used to detect antimicrobial activity in the urine of a subset of patients.

RESULTS

Training, assessment and protocols for reopening

The JHU course 'COVID-19: Effective Nursing in Times of Crises' was advertised as a learning tool for health workers, particularly nurses. It provided information for facility-level IPC management and other oversight for health care delivery in the pandemic. Important learnings for our research programs were: the need to explicitly delegate pandemic responsibilities to appropriately trained staff members, to provide clear safety training and information to all staff, to verify that training or information was understood, and to provide all safety and other pandemic protocols in writing. The course also emphasized use of local data to inform local response and the need to watch for mental health issues that could arise in staff working during a pandemic.

As recommended by the JHU course, we designated one research associate –with a background in biological science and public health– as pandemic safety officer and gave her full authority and responsibility to place pandemic-related concerns over any operational ones. She reports directly to the PI. We additionally appointed, again from within the cadre of existing research associates, two officers to manage PPE stocks and monitor donning and doffing of PPE by frontline workers. These officers undertook, in addition to IPC training required of all staff, a PPE training course offered by the United States Occupational Safety and Health Administration and were additionally trained to deputize for the safety officer whenever necessary. The PI, laboratory manager and safety officer performed daily monitoring of local pandemic status via the NCDC and Oyo State Taskforce websites and social media updates.

Based on course training, current WHO and NCDC directives, and in consultation with other team

members, the PI and safety officer mandated distancing requirements, IPC and other precautions, including minimal PPE requirements that would mitigate the risk of occupational SARS-CoV-2 infection in the health facilities in which we work. All these regulations were incorporated into the SOP, which was provided in writing to all staff members.

Procuring scarce PPE was the major determinant for resuming services: reopening was scheduled for a week after the anticipated delivery of the last PPE component. Thereafter, we continued to scope for PPE in order to keep procurement 2-4 weeks ahead of health facility activities.

In-house training gratuitously provided by the Oyo State COVID-19 Task Force included an overview of COVID-19; IPC as well as care, management, and a practical training in donning and doffing PPE. Median score on the post-training assessment was 73% and only 9 (33.3%) of 27 trainees attained the 80% passmark considered as indicative of sufficient knowledge. Among the findings from the assessment were that the specific uses, disinfection/ disposal protocols and limitations of different types of PPE were not sufficiently understood to make for correct decision-making on the job (Supplemental Table 1). Furthermore, whilst the assessment showed that staff completely understood the mode of transmission of the virus and the risk it posed to life and health, their responsibility in ensuring distancing and self-isolation when necessary were not entirely appreciated.

Based on our evaluation of the assessment results, we considered that more in-depth training than a single three-hour course was required. We therefore asked staff to complete what was then a new self-paced online course offered by the NCDC, which includes its pre- and in-course-assessments. Five staff scored <80% on the NCDC pretest, validating the need for the course. The NCDC course covered, in more detail, the nature of COVID-19, the mode of SARS-CoV-2 transmission and how to break the transmission chain, the screening for COVID-19 and patient triage, the standard IPC and transmission-based precautions and hand hygiene, the use of PPE, the need for surface and environmental cleaning and waste man-

agement, and essential health facility administrative, environmental and engineering controls and IPC in the COVID-19 context.

All staff took the NCDC course and those who scored under 80% on the in-house test were required to obtain certification before beginning work. Overall, this necessitated a two-week reopening delay. Staff took 5-14 days to complete the self-paced course. The safety officer conducted monthly refresher training on IPC and other pandemic precautions.

COVID-19 testing and workflow re-organization

A testing plan was deemed essential for reopening and considered that 27 staff in need of testing would not overburden the state's constrained testing system. Research assistants that enrol patients, research clinicians, phlebotomists, laboratory staff and their data tech support personnel were tested. Three of the 27 (11.1%) apparently healthy persons, all of whom would have had patient contact responsibilities, tested positive. From that point, staff who did not test negative, or reported symptoms or were contacts of anyone testing positive could only resume work after at least two weeks' isolation and a negative test. Contacts of staff testing positive were also tested. Daily temperature checks were instituted and only staff resuming with temperature less than 37.5°C were allowed workplace access.

We initially resumed activities at only half of our enrollment points. Staff with health conditions that placed them at higher risk of severe COVID-19, or who were responsible for at-home eldercare, were assigned telephone and data tasks to work from home until they could be vaccinated. Staff without these restrictions, but who could effectively perform their duties remotely (such as data officers), were also asked to work from home to reduce workplace occupancy and the risk associated with public transport commuting. 60% of the remaining staff were assigned to frontline clinical or laboratory work, four staff were given pandemic-support-related positions (one safety officer, two PPE management staff and an isolation facility liaison officer) and the rest asked to perform telephone-based or data tasks from

home and to remain on call should a frontline staff member call in sick or exposed. Our original plan was to have staff working from home complete extensive study and surveillance forms by telephone once consent and initial paperwork had been covered by frontline staff to reduce contact time of the latter with patients. However, this did not work because the staff at the entry points had fewer clients, which gave them time to complete the forms themselves and leverage the initial rapport developed while getting their consent at the time of patient enrollment. Staff working from home were therefore under-employed, motivating us to reopen two more enrollment points. However, we maintained some remote-working staff as this provided flexibility to encourage staff with symptoms to stay home. In the course of our operations, symptomatic staff repeatedly tested positive, prompting program-wide testing and, in two instances, temporary closures (Figure 1). All symptomatic infections were mild or moderate. Two staff with mild infections but high viral loads, as determined by low cycle thresholds at testing, were admitted to isolation facilities. Frontline staff were rotated on/off once a month and incoming front-liners were re-tested and provided refresher IPC/pandemic protocol training. All staff with patient contact were fully vaccinated with Oyo State Health workers as at the end of June 2021.

Appropriate PPE was provided to all research and facility staff (Figure 2) working at enrollment points and disposable facemasks given to patients or patient accompaniers that did not have them. The project office was surface-disinfected twice daily, deep-disinfected before reopening and after any occupant tested positive, and used for extended periods only by the program manager and safety/PPE officers. Other staff were requested to go home when not staffing enrollment points. Staff, collaborating investigators, vendors and dispatch riders who needed to access office or laboratory facilities were required to implement hand-hygiene protocols, be masked and to sign in and out. In the rural Ibarapa laboratory, where traffic to the lab is slower, staff were asked to sit distanced on the verandah outside between sample handlings instead of around the single desk within

the small laboratory.

PPE procurement, management and use

Nigeria rapidly saw drastic increases in cost and steep declines in the availability of PPE at the start of the pandemic, leading us to build re-opening plans around PPE procurement and stock management. PPE donations available within the country were prioritized for COVID-19 identification and care and use in government facilities and could therefore not be appropriated for research purposes.

As shown in Table 1, the price per surgical mask was the equivalent of US\$ 0.16 before the pandemic but rose to US\$ 0.76 in July 2020 in the domestic market. There was a 20% increase in the cost of safety boxes but N95 respirator masks, KN95 respirator masks, disposable gloves, biohazard bags, goggles, medical face masks, and infrared thermometers experienced 20 to 7000% cost increases. The pandemic also necessitated the use of other PPE, including full PPE and face shields, which were also procured at prohibitive rates. Purchase of PPE to protect our staff and collaborating facility health care workers was a significant budgetary stressor representing 52% of non-salary expenses in the six weeks following reopening. To get around scarcity and high pricing, we sought to procure in countries where we have research collaborators (specifically the Republic of Korea and the United Kingdom) but, due to export moratoria, we were unable to procure internationally until after August 2020. Once export restrictions were lifted, procurement of masks from the Republic of Korea and gloves, aprons, face-shields and respiratory masks from the UK took over seven weeks each.

Altogether, we initially sought PPE locally from seven local vendors, two of which were eventually able to fill a PPE order of 100 pieces or more. Procuring respirator masks for those involved in direct patient care was most challenging and we eventually settled for accepting a mix of N95, KN95 and FP2/3 masks, according to availability, which extended the nature of, and time needed for, training on proper PPE use. Additionally, because the variety of sources, purchased materials

had to be individually inspected and revealed that different respiratory grade masks (N95 catalogue number 8210 and vented 8810SSA) were sometimes repackaged together within N95 boxes. We were also not able to procure more than thirty disposable gowns. We, therefore, commissioned 32 reusable tailored gowns, which we doffed into detergent and bleach and then washed and recycled by a medical laundry service (Figure 2). This option had the advantage of reducing PPE disposal needs, which was also beginning to overwhelm our cooperating health facilities.

To enhance hand hygiene, we instituted a supplemental hand hygiene station at the entry of our offices and facilities we work with also made similar provisions at enrollment points. We also gave our staff bottles of hand sanitizer to carry on their person and placed additional bottles at strategic points in project work-spaces.

Impact on care

As at 15 September 2021, the NCDC COVID dashboard (<https://covid19.ncdc.gov.ng/report/>) indicated that 96,460 (48.1%) of 201,630 laboratory-confirmed COVID-19 cases in Nigeria were detected in Lagos State and the Federal Capital Territory, Abuja. Oyo state was however affected early in Nigeria's epidemic curve with prominent upswings in all three waves, and as at 15 September 2021, with 8,598 cumulative cases was the state with the sixth-largest cumulative number. As shown in Figure 1, Nigeria has seen three epidemic waves. Based on the drawn-out epidemic curve in our locality and worldwide, waiting for the epidemic to abate would have denied too many people non-COVID-19-related care.

In August 2020, when we reopened service in the pandemic, we enrolled a total of 61 suspected bacteremic patients at the Ibadan health facilities, compared to over 100 in the month of August in previous years, suggesting that fewer patients meeting enrollment criteria for surveillance were reaching our health facilities. Rates were comparatively low in September (Table 2).

In Nigeria, patients are known to seek low-cost care close to home, often from unsanctioned providers, only visiting hospitals and other formal health

facilities when self-medication with unprescribed antibiotics does not address their ailments. For this reason, we performed a urinalysis for antimicrobial inhibitors in a proportion of patients enrolled in surveillance. As Gram-positive organisms are susceptible to a broader range of antimicrobials, recovery of these organisms is most likely to be impacted by enrollee's antimicrobial pretreatment. We examined our retrospective data for blood culture yield, the proportion of the blood culture yield that is Gram-positive and the proportion of enrollees that have antimicrobial inhibitors in their urine. The data shown in Table 2 indicates that pretreatment was particularly marked in pandemic months August–September 2020 compared to the same months in 2017 and 2018. We, however, noted that the August to September indicators of antimicrobial pretreatment were similar in 2019 for reasons that are not entirely clear but could be linked to preceding industrial actions in the health sector.

We instituted a protocol for safe blood culture from patients in COVID-19 isolation facilities with suspected secondary bacteremia. We began to offer this service in late August 2020 and have been able to support management of 32 suspected secondary bacteremias at COVID-19 treatment facilities.

DISCUSSION

Routine clinical services and research activities that provide clinical care have, in many cases, been downsized or discontinued during the COVID-19 pandemic because of the overall burden of health care work and risk of hospital-acquired infections. Providing ancillary services during a public health emergency can expose more health care workers and patients to infection by the pandemic agent in cases where, as with COVID-19, diagnosis and triage cannot be effectively implemented at all points of care, and PPE is in short supply. On the other hand, withdrawing health services has long term consequences for population health. Patients will get to health facilities when they are sicker, if

at all, and are less likely to be successfully managed. Seven neonates needing urgent reportedly died because health facility staff were diverted by COVID-19 emergencies or on strike in Zimbabwe is a troubling case in point (10). Safely reinstating essential health services paused by the COVID-19 pandemic should be a priority, particularly in lower-income settings (5).

We conduct routine surveillance for blood-borne bacteria and antimicrobial resistance at health facilities in Nigeria. Our work provides laboratory diagnostic support to patients at no cost, improving diagnostic stewardship for patients in general and providing access for the many low-income patients that cannot afford to pay out-of-pocket for testing. Thus, when these services were closed at four urban and one rural facility the implications for access to care were considerable [<http://www.chidoonumah.com/whistleblowing-covid-19-sparks-rising-deaths-in-nigerian-hospitals-due-to-lack-of-ppe-for-healthworkers/#>]

While biased towards our interest in invasive salmonellosis, our surveillance data suggest that fewer patients are visiting health facilities during the pandemic and that those that do are more likely to have pretreated with antimicrobials before presentation than patients visiting at a similar time in years prior. Despite diminished attendance, reopening provided diagnostic testing for over 60 suspected bacteraemic patients in Ibadan and Ibarapa through our programs in August 2020 alone.

Health workers at the forefront of the COVID-19 pandemic have a grossly elevated risk of contracting and dying of COVID-19 compared to the general population. They can also create SARS-CoV-2 transmission chains, particularly if stringent IPC protocols are not followed (11). COVID-19-specific training has been shown to be important for ensuring that health workers exhibit the necessary knowledge, attitudes and practices to operate safely in this pandemic (12). For these reasons, we prioritized training staff, providing PPE and instituting IPC measures. Health professionals' schooling on infectious viral agents and their transmission contributes to increased but

not absolute knowledge and attitudes in the pandemic (13). However, health worker knowledge, awareness, and importantly practice gaps documented (13). We found that a didactic instructional session, modelled along lines earlier used to impart project research and health care delivery skill training was insufficient to raise knowledge levels for safe work in the pandemic. Moreover, questions asked around practice on the assessment, so-called 'what should you do in this situation?' questions, were least likely to receive correct answers after that training program (Supplemental Table 1). We, therefore, found it necessary to administer self-paced, continuously assessed and reflective training. Delivery of a suitable course online by NCDC this implementable at the height of the pandemic. An analogous, reflective, multimode facility-management course from FutureLearn/JHU proved invaluable for the PI and safety officer to manage resumption and address unexpected hitches in the plan.

PPE in Nigerian health systems has hitherto been imported from abroad. It was scarce and prohibitively expensive at the start of the pandemic. Health worker infections were commonplace outside COVID-19 treatment facilities, supplied with donated PPE, due to generalized unprotected caregiving. For the same reason, the pandemic saw several health worker strikes and health facilities (including those we work with) turning away all but emergency patients, and in particular febrile patients, who were more likely to have malaria, typhoid fever, bacteraemia or other common endemic infections that are amenable to easy treatment if diagnosed. We were able to procure limited quantities of PPE for judicious use by our, and health facility, staff because of the extramural support for our projects and the flexibility or permission granted to use funding originally earmarked for other purposes to purchase PPE. However, even in these extenuating circumstances, PPE procurement consumed far greater time and expense than we could afford and future pandemic preparedness in Nigeria, and other African countries, must include a move to promote the local production and quality assurance of medical-grade PPE among other key consumables required

for a robust pandemic response (14).

Testing, another resource-intensive essential requirement for pandemic control that is entirely dependent on imported materials and therefore in short supply, was the component of our reopening plan that we were most concerned about being able to sustain. As has been demonstrated with larger data sets from the UK, judicious testing strategies are essential to prevent the health care facilities from becoming COVID-19 acquisition “hubs” (15). Our initial tests (with 3/27 positives) provided sufficient justification for continuing to use testing, albeit less frequently than is employed in resource-rich settings, to protect our workforce and patients. High positivity rates we encountered among our staff during pandemic peaks (Figure 1) are borne out by similarly high asymptomatic rates in other African countries (16, 17), which were inadequately documented because exposed and symptomatic individuals were necessarily prioritized for scarce testing, and justifies the need to prioritize routine testing of health care workers in particular.

While the interventions we put in place were largely focused on operating safely within the context of the COVID-19 pandemic, it is hoped that the stronger focus on patient safety, occupational hazards, IPC and WASH within our research program and partner facilities will have long term benefits and focus future development on areas of primary and general need (18)

As research and care teams that work directly to improve bacteraemia diagnosis, we were concerned about the bacteraemia risk for COVID-19 patients, which may be inherent to the disease and exacerbated by essential invasive supportive therapy (19). Diagnostic support for presumed secondary bacteraemia can help to prevent unnecessary antimicrobial use, an ongoing concern in the COVID-19 pandemic (20). Managing secondary infections efficiently as well as successfully is important for reducing ICU occupancy and therefore increasing access to the specialized care that could forestall mortality. Adequate bacteriology laboratory support also helps to identify and contain outbreaks of hospital-acquired bacteria, which are

often multidrug-resistant (21). In New York City, five hospitals ordered 88,201 cultures from 28,011 patients between January and March 2020, eventually overwhelming the city’s blood culture capacity (22). Maximum blood culture capacity in Oyo State is several orders of magnitude smaller, with most (but not all) existing capacity supplied through our projects. It is therefore critical, even for COVID-19 project care, that we were able to reopen our service.

CONCLUSIONS

We developed and implemented a reopening plan for our research and surveillance teams to safely provide diagnostic support and surveillance for blood-borne bacterial infections at health facilities during the COVID-19 pandemic. We learned to identify and use enhanced staff training resources, to use testing to prevent health facility transmission and met and overcame significant challenges with PPE procurement. Protocols for safely operating in pandemic situations and supporting COVID-19 treatment facilities with blood culture for suspected secondary bacteraemia added value to reopening research-based diagnostic services. Altogether, the increased access to care that returns to research and surveillance activities afforded may help to forestall injudicious antimicrobial use, and thereby promote antimicrobial resistance containment.

INFORMATION

Acknowledgements. We thank the Oyo State COVID-19 task force, the Nigeria Centre for Disease Control, Futurelearn and the Johns Hopkins University School of Nursing for direct and online COVID-19 response support. We are grateful to David Adebayo, Adepoju Adesola, Kathryn Holt, Yeonseon Kim, El-shama Q. Monu-Nwoko, Paul Olatinwo, Victoria Okeleye, Faith I. Popoola, K. Salami, Dr. Adedotun Adetunji, Dr. Kehinde Ojifini, Prof. Ikeoluwa Lagunju, Dr. Obioma Uchendu and Dr. K.M. Kuti for technical assistance and logistic

support.

Authors' contributions. VOO, OPO, OP, AK, OA, IU and TA planned the practice interventions, VOO, OPO, OP, AK, IU, IA, JJA, FB and ODM implemented the interventions, VOO, OPO, IU, SA, IA, JJA and INO collected and collated data to evaluate implementation. VOO, INO, TA, ODM and FM recruited resources for the initiative. INO and OPO prepared the initial manuscript draft. All authors contributed to writing the final manuscript.

Conflict of interests. None.

Funding. This work is supported by the Bill & Melinda Gates Foundation Award OPP1127988 as well as by Grand Challenges, an initiative of the Gates Foundation (Award OPP1210746). I. N. O. was an African Research Leader supported by the UK Medical Research Council (MRC) and the UK Department for International Development (DFID) under the MRC/DFID Concordat agreement that is also part of the EDCTP2 program supported by the European Union. The funders had no involvement in the content, writing, or submission of this paper.

Ethical considerations. Approval for our bacteraemia surveillance work was granted by the University of Ibadan (UI)/University College Hospital (UCH) Ethics Committee, Ibadan, Nigeria (UI/EC/16/0389) and the International Vaccine Institute (IVI) Institute Review Board (IRB), (2015-006). COVID-19-specific human research described in this report was approved by the UI/UCH Ethics committee, approval number UI/EC/20/0273. Participants or their parents/guardians provided written informed participation to participate in the study and patient identifying information is kept confidential.

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How to cite this article: Ogunleye V.O., Oluwalusi O.P, Popoola O., Kehinde A., Adekanmbi O., Udofia I., Agbi S., Akintayo I., Ajiboye J.J., Bamidele F, Alonge T., Mogeni O.D., Marks F, Okeke I.N.**Restoring non-COVID-19 clinical research and surveillance in Oyo state, Nigeria during the SARS-CoV-2 pandemic.** *Journal of Public Health in Africa.* 2022;13:1720. <https://doi.org/10.4081/jphia.2022.1720>



FIGURE 1: Epidemic curve for Oyo State from 26 February to 15 September 2021 with positive cases from within our surveillance/care workforce marked as red or gold stars if detected for the first or repeated time in the same individual. Green-boxed syringes mark the dates that frontline staff received their first and second doses of the Oxford/AstraZeneca COVID-19 vaccine. Yellow-boxed syringes are the respective vaccination dates for non-frontline staff. State data are from the Nigeria Centre for Disease Control <https://covid19.ncdc.gov.ng/state/>. The bar at the bottom of the curve indicates when our services were open (green) and when they were closed for COVID-19-related (red) or other (grey) reasons.

TABLE 1: Cost of Personal Protective Equipment (PPEs) pre-pandemic.

Personal Protective Equipment	Unit price (N) in pre-pandemic	Unit price (N) in July 2020 (pandemic peak)
N95	2500	3750 (if available)
KN95	1000	1800 (if available)
Gloves (pack of 100)	2000	4000
Biohazard bags	600	1000
Goggles	500	3800
Safety box	500	600
Medical face mask	20	1400
Infrared thermometer	7500	30000

On 6 November 2020: 1 N (Nigerian Naira) = 0.00261466 US\$.

TABLE 2: Surrogate indicators of patient access to care and health facility avoidance.

Data from Ibadan Enrollees in August-September of year	Total number of patients enrolled and blood cultures performed	Blood culture positives (% Yield)	No (%) of likely pathogens recovered that were Gram-positive	% of blood cultured patients that were Urotest®-tested	Proportion of Urotest®-tested patients with antimicrobial-free urine
2017	181	30 (16.6)	19 (63.3)	69.6	61.1
2018	225	26 (11.6)	16 (61.5)	52.9	68.9
2019	227	6 (2.6)	2 (33.3)	31.3	56.3
2020	120	5 (4.2)	1 (20)	40.8	55.1



FIGURE 2: Standard PPE ensemble for staff with patient contact after reopening included medical masks, launderable gown and gloves. Respiratory masks, not shown, were used by staff engaged in high risk operations.