

## Africa, Laboratory Equipment and COVID-19 Response

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By

As the world struggles to address the COVID-19 crisis, attention increasingly turns to laboratories and the crucial role that they play in diagnostics and research. A rising number of reports from multiple countries detail these problems: lack of laboratories, reagents, technicians, and equipment form bottlenecks in both diagnosis and the race for a viable vaccine.

As COVID-19 cases start to appear on the African continent, questions about laboratory capacity become even more pertinent. The 2014–2016 Ebola pandemic clearly illustrated the challenges of managing pandemic responses in contexts with underresourced health infrastructures and strained laboratory testing capacity (Bell et al. 2016). In the case of the Ebola pandemic, these shortfalls were offset by a significant and sustained international response that brought equipment, testing capabilities, and streamlined supply chains into affected areas.

Many of the countries that contributed to the international Ebola response of 2014 are currently dealing with national COVID-19 crises. This has led to considerable discussion amongst non-governmental organizations and other stakeholders about how best to strengthen African laboratory capacity in ways that do not rely on large-scale, internationally coordinated responses. In particular, a number of suggestions have focused on increasing research laboratory capacity, either to galvanize in situ COVID-19 research or to provide alternative sites for conducting COVID-19 testing. Suggestions include the following:

- Secondhand equipment donations from laboratories in high-income countries (HICs)
- Support for Open Source Hardware (Rubow 2008) and the fabrication of low-cost equipment in situ
- Redirecting existing equipment brokerage schemes that negotiate equipment purchases for higher education institutions in low/middle-income countries
- Mapping research laboratory resources to facilitate the sharing of equipment and analysis of samples
- Encouraging distributed research practices

While these options are proposed with good intentions, none of them are unproblematic. Indeed, an existing body of literature within development studies, science and technology studies, and research capacity discourse offer important words of caution.

### **Situating laboratory equipment in low-resourced settings**

First and foremost are observations about existing infrastructural challenges that have been reflected in literature on building research capacity. Empirical studies (Bezuidenhout 2017; Bezuidenhout, Kelly, et al. 2017; Pollock 2014; Tousignant 2013; Fine 2007; Masanza et al. 2010) have detailed the challenges of optimizing the functioning of laboratory equipment not designed for the situational challenges presented by low-resourced settings. Such challenges range from power outages and low bandwidth, to systemic challenges such as corruption and inherited colonial institutional design. These issues are complicated by the scarcity of in-country technical support, which complicates maintenance, calibration, and optimization.

Inefficient supply chains present further challenges, making the acquisition of reagents, replacement parts, and other disposable laboratory items complicated and very expensive (Zhang et al. 2016; Thairu, Katzenstein, and Israelski 2011). In many African countries, these items are acquired via one (or more) private agencies that act as brokers for HIC companies. Not only does the presence of these middlemen increase the final price of consumables, but it also increases the time from ordering to delivery. These convoluted supply chains also present a significant hurdle for individuals who purchase consumables outside of traditional institutions (universities and diagnostic laboratories). Such business practices require considerable attention for any proposals aimed at engaging citizen science activity for COVID-19 response.

### **Understanding institutional realities**

The heavy price tags of consumables, together with the low exchange rates of many local currencies and the difficulties of conducting foreign transactions, present more than financial challenges. These issues are also influential in determining institutional support and buy-in to any COVID-19 activities. Most African institutions rely almost entirely on student fees and hard-won grants to equip their laboratories (Johnstone 2003; Cloete et al. 2006). This means that the scarce resources present in laboratories are carefully judged to meet undergraduate and postgraduate educational needs, or to fulfil the deliverables of a specific grant. In this way, institutions may struggle to support additional activities that detract from these core objectives, particularly when they are already dealing with the financial precarity of indefinite closures. Moreover, they are unlikely to

be in a position to provide the institutional “core funding” for laboratories – something that keeps most HIC laboratories running smoothly and allows the flexibility to add additional activities.

### **The complexities of shared equipment**

Efforts to build research capacity in Africa have strongly supported the development of “centres of excellence” (CoEs) that provide national and regional expertise in specific subjects (Nordling 2018b; African Union 2005, 2014). These CoEs, by virtue of dedicated and sustained funding, often have laboratories with more resources than other research and teaching institutions. Indeed, as detailed in emerging empirical studies (Bezuidenhout, Leonelli, et al. 2017; Fine 2007; Tousignant 2013), many other institutions continue to struggle to equip laboratories and maintain equipment. Nonetheless, it is surprising to suggest that equipment access be opened beyond individual institutions to offset these distributional inequalities. African institutions, like their HIC counterparts, are responsible for the safety of individuals working on their sites. Combined with the challenges of sourcing reagents and maintaining equipment, the introduction of unverified individuals into laboratories presents a significant drawback to open equipment access.

It must be noted that such challenges, it must be noted, have been similarly encountered in HICs. Indeed, [attempts to develop a log of laboratory equipment](#) in the UK [have foregrounded the challenges](#) relating to issues of ownership, liability, and maintenance. In contrast, attempts to bolster access to equipment through open hardware/ or self-constructed equipment has have met similar challenges. The widespread integration of such equipment into research and diagnostic pathways continues to face challenges around the globe on issues ranging from calibration to safety. Moreover, while many African countries have less -developed legislative frameworks governing laboratory safety and security, the absence of such regulation cannot be used as a precedent for overlooking these well-recognized concerns.

### **Data sharing and distributed research**

It is widely recognized that the success of COVID-19 responses depends on access to data. Indeed, all over the world, data producers, repositories, publishers, and libraries [are working to maximize access to data pertinent to the COVID-19 response](#). These activities include the removal of paywalls, optimizing the FAIR-ness (findable, accessible, interoperable, reusable) of data, and supporting platforms that assist community collaboration and sharing.

Many African researchers and data stakeholders are already contributing

to these international activities. Nonetheless, there are concerns that the scope of their contribution is limited by a range of issues characterizing the African data and publication landscape. These vary considerably, and include publishing challenges faced by a number of regional or national African journals (Tijssen 2006; Smart 2005). These small-scale publications do not have the capacity to digitize back catalogues of publications, meaning that published works are only available as abstracts online. Making these papers available, however, is not simply a case of finding funds and volunteers. It requires publishers to be engaged and their copyright requirements scrutinized to ensure that they are adequately respected.

Data-related challenges include a dearth of systematic training in research data management, a poorly coordinated continental network of repositories, and high turnovers of graduate students (Dlamini and Snyman 2017). This means that considerable amounts of data created in African research institutions remain un-FAIR and cannot be easily added to online collections in their current state. Making such data reusable and ready for deposition into repositories will require not only time, but financial commitments and technical support.

Issues of sharing data are also compounded by the personal concerns of researchers. Like their HIC colleagues, many African researchers express concerns about loss of control over data, lack of credit, scooping, and malicious reuse (Bezuidenhout 2018). Furthermore, promotion criteria in most African institutions are almost solely dependent on the publication of peer-reviewed articles, which makes the sharing of unpublished data seem like a career gamble. Such issues have been shown to significantly affect individual buy-in to Open Data discussions (Bezuidenhout et al. 2016), and cannot be overlooked.

### **Over- and under-estimating research capacity**

While African research outputs may lag behind many other regions of the world, research on the continent is growing. Over the last years, national and international funding has increased research capacity, strengthened inter-African collaborations, and built up strong networks of research excellence (Marsh 2016). In addition to the CoEs, these changes should foster a justly optimistic representation of research on the continent.

Nonetheless, it is important to note that the majority of African higher education institutions continue to be poorly resourced, and most researchers working in these settings rely on personal networks and other highly individual practices to continue to produce data in this environment. Nonetheless, such practices (and the conditions of these laboratories) are extremely poorly documented in the literature. As a result, many

discussions on African research either overestimate research capacity by focusing on CoEs, or underestimate it by assuming that nothing occurs outside of the CoEs.

The lack of engagement with this less visible sector of African research is problematic for COVID-19 responses for a number of reasons. Not only does it complicate discussions on feasible diagnostic and research responses, but it also stops the sharing of African expertise that could potentially be the most impactful. Namely, the ways in which African researchers creatively confront the constraints of low-resourced research settings, and the creative work-arounds that they have developed to deal with these challenges.

### **Calibration and testing challenges**

In addition to the challenges of redirecting scarce laboratory resources to COVID-19 responses described above, there are a range of other challenges associated with repurposing research spaces for diagnostic activities. In HICs, the challenges of ensuring reproducibility, avoiding false positives/negatives, and ethical issues such as data protection, privacy, and anonymity have meant that few research laboratories are currently integrated into diagnostic COVID-19 response activities.

Similar issues would undoubtedly be present if such a model is attempted in Africa. Moreover, these challenges would be compounded by the known difficulties of transporting samples (Kassambara et al. 2020), unreliable infrastructures complicating storage and disposal of samples, and varying provision of information and communication technologies (ICTs) complicating communication between research institutions, clinics and hospitals.

Moreover, many research laboratories in Africa rely predominantly on the labour of masters and PhD level postgraduate students for data production. There is a comparatively low number of postdoctoral or early career researchers, technicians, and technical staff. This would mean that COVID-19 analysis would likely be done by students who, while competent, should not be predominantly relied upon to provide such services.

### **Conflicting narratives and motivations**

The urgency of mobilizing COVID-19 responses requires the sharing of resources and expertise. Many organizations already working to improve STEM (science, technology, engineering and mathematics) literacy, research, innovation, and education in Africa are starting to collaborate on response-related activities. While the pooling of expertise, networks, and

resources is sensible, such actions are not without their challenges.

The higher education/research landscape in Africa is complicated, as current discussions on decolonizing curricula, research and institutions attest to (Roy 2018; Okune 2019; Nordling 2018a). The organizations working within this landscape engage with this complicated past and present in different ways, and their activities reflect not only their values but also their interpretation of the landscape and its problems. As a result, many of the organizations coming together to collaborate on COVID-19 responses represent highly disparate (and potentially conflicting) responses to the same challenge: building STEM capacity in Africa. Unpacking these conflicting narratives of capacity-building, post-colonial independence, ownership, and autonomy is not only difficult, but vital.

### Concluding comments

This commentary is not intended to scorn well-intentioned activities that aim to support the COVID-19 response in Africa. Instead, it aims to draw attention to the wealth of literature that has outlined the significant challenges of equipping, maintaining, and running laboratories in low-resourced settings. It is by recognizing these challenges that COVID-19 activities can sidestep the dangers of imposing perceptions and actions onto already burdened African researchers. Instead, it is vital that African researchers lead discussions on how to address the problems of laboratory equipment. It is true that Africa needs more laboratory equipment, but it needs it in ways that are neither idealistic nor unrealistic.

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[Louise Bezuidenhout](#) is a research fellow at the Institute for Science, Innovation and Society at the University of Oxford, UK. Her research focuses on strengths and challenges experienced by researchers based in low-resourced research settings. Much of this work focuses on the challenges surrounding the production, dissemination and re-use of research data. She has informed her research by embedded fieldwork in research institutions across Africa, Europe and North America.

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