

END OF AWARD REPORT

Report Type	GHR End of Award Report
Due Date	30/06/2022
Submitted Date	31/03/2022

PROJECT DETAILS

Programme	Research Costs
Global Health Research Units and Groups	6,886,852.00
Project Reference Number	Chief Investigator
16/136/33	Woolhouse, Mark
Project Title	
NIHR Global Health Research Unit on Tackling Infections to Benefit Africa, The University of Edinburgh	
Name and Address of Host Institution	
The University of Edinburgh	
Start Date	
01/06/2017	
End Date	
31/01/2022	

END OF AWARD REPORT QUESTIONS

Please summarise the key scientific findings

TIBA is a wide-ranging, multi-disciplinary research and delivery programme designed to help diverse African health systems tackle infectious diseases more effectively. Our aims are to improve the diagnosis and surveillance of infectious diseases in resource-poor settings, improve the deployment of existing drug treatments and vaccines and enhance local capacity to develop new ones, and improve the management of both endemic and emerging infections.

TIBA is a partnership between the University of Edinburgh and researchers in Botswana, Ghana, Kenya, Rwanda, South Africa, Sudan, Tanzania, Uganda and Zimbabwe, plus delivery partners including WHO Africa Region, the African Academy of Sciences and the Africa Union's New Partnership for Africa's Development.

TIBA's works on a set of largely neglected diseases that affect our partner countries: schistosomiasis, malaria, trypanosomiasis and lymphatic filariasis, plus selected comorbidities, and on epidemic threats including COVID-19.

TIBA's activities are structured as a set of 6 integrated work packages (WPs): WP1 and WP2, health and health systems research projects; WP3, lessons learned for strengthening health systems; WP4, training and capacity building; WP5, dissemination; WP6, epidemic preparedness.

During 2017-22 TIBA delivered four major planned outputs:

1. Our researchers completed 55 research projects and produced 97 peer-reviewed scientific publications and registered 160 IP assets. We met 70 milestones and deliverables (see Outputs).
2. TIBA's research generated knowledge and innovation for health policy and for healthcare service delivery in Africa. Our priority diseases disproportionately affect poor, rural communities and women and/or children and our work was aligned to health research priorities identified by national governments and international agencies. TIBA contributed to national and continental global policy documents (see Impact).
3. TIBA met an often articulated but rarely addressed need to view infectious disease management not in isolation but in the context of local health systems and wider societal issues. We have helped to improve the health research environment in Africa, providing a rare opportunity for different countries to work together in a common framework (see Achievements).
4. TIBA trained 33 postgraduates in-country and 22 fellows via our Out-of-Africa fellowship programme. We hosted almost 1000 trainees at local and TIBA-wide training events. Seven TIBA PIs received academic promotions (see Training & Capacity).

TIBA abides by four guiding principles: our research is Africa-led; we shift the centre-of-gravity for research on Africa to Africa; we aim to create equitable partnerships; we strive to be wholly inclusive.

TIBA relies on community engagement and involvement (CEI) for identification of research project topics (co-creation), dissemination, translation into policy and practice, knowledge uptake and implementation (see Engagement & Involvement).

Project duration was 56 months from June 2017 to January 2022.

The ways in which TIBA has delivered measurable benefits in LMICs, how findings have advanced knowledge in the field, future research recommendations, implications for policy and practice, and lessons learned are set out in the following sections.

By all available metrics, TIBA was one of the best-performing NIHR Global Health Research Units,

but our application for renewed funding was rejected.

Project achievements: please report per outcome of your project

All project milestones were completed except our final AGM which was cancelled due to the COVID-19 pandemic. Three extra milestones/deliverables were added: CEI workshop, Good Financial Grants Practice (GFGP) workshop; and an independent monitoring, evaluation and learning (MEL) review (Supporting Document).

Project milestones are set out in the TIBA project management plan (see Upload to this and previous reports to NIHR). Evidence of completion has been shared via MIS.

Reporting milestones. There were 10 milestones for reporting to NIHR. All were completed culminating with this final report submitted on 30/3/22.

Management milestones. There were 7 milestones for project management and finances. Six have been completed; the final financial report is due on 30/4/22.

Training milestones. There were 17 milestones for training activities (WP4). All were completed by 31/10/21.

Research milestones. There were 10 milestones for research projects (WP1,2). All were completed by 31/11/20.

Impact milestones.

There were 12 milestones for lessons learned, dissemination and engagement (WP3, WP5) – all were completed by 31/10/21 except for the final AGM which was cancelled due to COVID-19.

Epidemic response milestones.

There were 10 milestones for epidemic response work (WP6) – all were completed by 31/10/21.

Each organisational partner on our Delivery Chain Map (DCM) contributed significantly to at least one work package as set out on the DCM. Each of our ten core African partners developed and delivered a Rapid Impact project (WP1) and a Data Science project (WP6). Four partners led a Making a Difference project (WP2) and all participated in at least one of these projects. Six partners (Botswana, Ghana, Kenya, Rwanda, Sudan and Zimbabwe) contributed to epidemic response work (WP6). All core partners hosted TIBA-funded PhD projects and recruited Out-of-Africa Fellows (WP4). Six partners (Ghana, Kenya, South Africa, Sudan, Rwanda and Zimbabwe) hosted in-person training workshops and trainees from all partners attended TIBA workshops (WP4). Three non-core partners added during the project contributed to WP5,6 (WHO AFRO) and WP1,2 activities by TIBA Uganda (AVIA-GIS and Bardosh). All partners were involved in dissemination activities (WP5). Tool-kit projects (WP3) were the responsibility of TIBA Edinburgh.

TIBA's output of 97 peer-reviewed journal publications far exceeds any other GHR Unit. 85% of first authors and 69% of last authors on TIBA papers were based in LMICs. The equivalent figures for all other GHR Units were 34% and 27%. First authorships are a key metric for early career researchers, as are last authorships for more senior researchers, and so these data demonstrate that TIBA publications were directly benefitting LMIC researchers to a far greater extent than other Units.

We highlight 3 publications as indicative of TIBA outputs.

TIBA Zimbabwe led a study published in BMJ Global Health in 2018 on lupus, which occurs more frequently in patients of African descent with high morbidity and mortality. Our key finding was that there exists a large subgroup (54%) of Southern African patients whose laboratory tests differ from

the standard international guidelines for lupus diagnosis. The team identified the antibody reactivity pattern that underlies this lupus variant to improve diagnosis. These findings have been widely disseminated to patient groups and clinicians.

TIBA Rwanda led a study published in Nature Communications in 2021 that used locally generated SARS-CoV-2 genome sequences to demonstrate an important role of neighbouring countries in seeding introductions into Rwanda, highlighting the importance of co-ordinated genomic surveillance and regional collaborations for responding to COVID-19.

A TIBA-WHO AFRO collaboration published an analysis in Nature Medicine in 2021 showing that African countries rated as better prepared and having more resilient health systems were worst affected by the disease, the imposition of restrictions or both, making any benefit of more stringent countermeasures difficult to detect, concluding that the COVID-19 pandemic highlighted unanticipated vulnerabilities to infectious disease in Africa that should be taken into account in future pandemic preparedness planning.

We highlight 3 of over 100 presentations and posters as indicative of TIBA outputs.

Francisca Mutapi attended the 2019 Grand Challenges Annual Meeting held in Addis Ababa, Ethiopia. She took part in discussions on 'African Research, Development and Innovation Ecosystem', exploring challenges and opportunities to further strengthen African R&D so that innovative solutions can be discovered, developed and delivered to those most in need. She also took part in the African Scientific Advisory Committee sharing updates on the scientific prioritization exercises, processes and timeline happening on the content with the African scientific community on key health and development challenges.

Gordon Awandare gave an invited presentation at the 2019 ASTMH meeting in Maryland, USA on 'Characterization of Plasmodium falciparum armadillo-type repeat protein'. He and his team used homology-based structural modelling to identify multiple copies of Armadillo repeats within one uncharacterised gene expressed during the intraerythrocytic stages. His team used a bacterial expression system to screen plasma samples from malaria endemic areas in Ghana, which revealed that malaria-infected children have naturally acquired PfATRP-specific antibodies, with prevalence varying across transmission areas.

Faith Osier delivered the keynote during the on-line 'Black in Immunology Week' in November 2021 where she spoke on 'Making malaria history'. The event celebrated the scientific contributions of Black immunologists. She highlighted that burden of falciparum malaria remains high in sub-Saharan Africa, leading to preventable deaths of children under the age of five years. Faith explained how her team is using human controlled challenge experiments to identify prospective and viable malarial antigen candidates for the development of vaccines that provide long lasting and effective immunity.

We highlight 3 of over 20 policy briefs.

In October 2020, TIBA Ghana in collaboration with colleagues at the Noguchi Memorial Institute for Medical Research shared a policy brief with the Ghana Minister of Health in relation to the results of COVID-19 seroprevalence studies in the Greater Accra and Kasoa areas. They successfully screened 1305 individuals at three (3) major markets/lorry stations, two (2) major shopping malls, three (3) hospitals and two (2) research institutions involved in COVID-19 work. Participants were screened with a lateral flow type Rapid Diagnostic Test that simultaneously detects IgM and IgG antibodies to SARS-CoV-2.

TIBA Kenya and KEMRI WTRP researchers used mathematical models to project COVID-19 cases and deaths following schools reopening and recommended the following to the Kenyan Government: maintain public health messaging on preventive measures; enhance measures to reduce the risk of transmission in schools, such as physical distance and hand hygiene.

TIBA Zimbabwe/Edinburgh highlighted the strengthening of the COVID-19 response in Zimbabwe through diagnosis of frontline health workers. As a result, the Government of Zimbabwe agreed that research was needed to strengthen the national COVID-19 response with the objectives of evaluating

uptake and impact of antibody and PCR testing of frontline health workers, validating antibody tests in Zimbabwe, describing the sero-epidemiology of COVID-19 in frontline health workers and understanding the nature and dynamics of the cytokine storm in COVID-19 patients. The main policy implications were focused on knowledge attitudes and practices, SARS-CoV-2 testing, and reducing hospital and community infections.

We received an award from the Financial Assurance Fund (FAF) which was used to run a Good Financial Grant Practice (GFGP) workshop in Rwanda in February 2020. Kenya and Rwanda also used their FAF awards to develop new grant management systems to support their global health related research.

TIBA's SARS-CoV-2 genome sequencing work was a good example of shifting the centre of gravity for health research on Africa to Africa. This process began with a hands-on training workshop in Accra, Ghana in December 2018, continued with support for virus sequencing projects in Botswana and Rwanda, and extended to Ghana, Kenya and Sudan at the start of the COVID-19 pandemic. TIBA partners generated over 2000 virus genome sequences, 15% of Africa's contribution as of 10/02/22. TIBA thus contributed to a transformational shift in capability that during the current pandemic has helped Africa to generate sequence data locally on a continent-wide scale.

Our independent End of Programme MEL review concluded: "TIBA's ambitious aim to shift the centre of gravity of health research remained central to TIBA activities and there is strong evidence that TIBA has achieved this. TIBA's governance and management processes enabled African partner institutions to define the agenda and direction of their research, whilst enabling African-led peer review to ensure academic excellence and rigor. African leadership was a very real and valued part of TIBA. The programme made very positive and tangible impact in relation to capacity building of African scientists and health researchers and to contributing to the academic evidence base on African health systems and infectious disease. All TIBA partners have benefitted from access to training and capacity-building opportunities, with all TIBA training events held in Africa, in Edinburgh or online to build local capacity to deliver training."

Impact: identify interesting material for communication to various audiences

TIBA's work was Africa-led. Our research projects and training goals were put forward by our African partners. We asked that proposals be designed to meet national and continent-wide strategic health research goals and needs, contribute to agreed health agendas and engage directly with affected communities. Each research project examined how its findings could be integrated into the local health system. This has contributed to our understanding on responses to changes in policy, new scientific knowledge or technological innovation, and to external challenges such as the COVID-19 pandemic. Our African colleagues placed great emphasis on operational, delivery and implementation research – this was reflected in our research strategy. We find that our approach has delivered wider engagement, mutual understanding, opportunities to share best practice and a sense of shared purpose, plus learning opportunities for proposal writers and assessors alike, all ultimately leading to far better and higher impact research.

TIBA's work contributes to UN Sustainable Development Goals SDG3 targets 3.2 (reducing child mortality), 3.3 (end epidemics), 3.8 (universal health coverage), 3.B (research on vaccines and medicines) and 3.D (capacity to respond to health threats). Our work is also in line with SDG5 on inclusivity and with the Transformation Agenda of the WHO Secretariat in the African Region (2015-2020).

Key TIBA's research outputs to date include: i) a landmark series of studies of markers for schistosomiasis infection and disease, particularly in young children; ii) generation of 12,386 SARS-CoV-2 genome sequences, thus helping to elucidate the epidemiology and evolution of SARS-CoV-2 and informing respective national responses to the pandemic in Botswana, Ghana, Kenya, Rwanda and Sudan; iii) developing a microarray to facilitate selection of malaria vaccine candidates; iv) studies of community attitudes to helminth infections in South Africa and trypanosomes in cattle reservoirs in Uganda; v) identifying biological markers of transmission and characterising hotspots of lymphatic filariasis. All these studies are fully described in peer-reviewed scientific publications

deposited on MIS.

On African health research in general, TIBA collaborated with WHO and European and Developing Countries Clinical Trials Partnership (EDCTP) to assess WHO AFRO member countries using a national health research systems barometer. We collected and analysed data from 47 WHO AFRO member countries and our findings were presented to ministers of health at the 68th session of the WHO Regional Committee in Dakar, Senegal in August 2018. Based on the results countries were charged with developing national strategies for improvement with a view to being reassessed in two years' time. A technical report of this work has been published.

On policy, we worked with AUDA-NEPAD to assist in the development of the Health Research for Innovation Strategy for Africa (HRISA) 2020-2030 (see Outputs). We also worked with the African Vaccine Manufacturing Initiative (AVMI) to design a roadmap for an African Vaccine Policy. AVMI has identified the lack of an Africa-wide policy on vaccines as a key impediment to accelerating local vaccine manufacture. A TIBA workshop in 2019 brought together industry, policy makers, academia and global health actors under the guidance of AVMI and AUDA-NEPAD to: i) create a roadmap for designing and adopting an Africa level policy on vaccines, ii) integrate the vaccine policy in the AU's model law on medical health technologies, and iii) use the policy to promote an integrated and collaborative approach to local R&D leading to increased manufacture of vaccines on the continent.

On practice, with AUDA-NEPAD, AAS, African Regional IP Organization and the Regional Economic Communities we ran a workshop on how Intellectual Property (IP) rights can be leveraged by SMEs in the pharma sector. IP is an asset that has not been strategically leveraged in Africa.

Our approaches to promoting long-term sustainability included: i) developing nascent and mid-career researchers and facilitating their local, regional and international networking; ii) providing equipment and research resources for the trainees to ensure sustainable technology transfer, so that knowledge can be cascaded within the home institute; iii) forging relationships with industry and policy makers nationally and internationally.

TIBA's legacy is linked to the local ownership of our research by partners and communities as we respond to their needs and health priorities of African governments. TIBA-facilitated research and capacity have been institutionalised and nationalised thereby attracting additional government, stakeholder, and other funding in all partner countries leaving a legacy for continuity for endemic disease research and future national responses to disease outbreaks and epidemics. Our projects feed into our partners' research that continues in the absence of additional NIHR funding. This was evident during the 10-month no-cost extension where African partners were supporting TIBA rather than TIBA supporting them.

TIBA has an active working relationship with multiple funders beyond NIHR. We hosted a 'Funder's Forum' at our 2019 AGM with contributions from AAS, Wellcome Trust, DAAD, Merck Global Health Institute, Access Bank and AUDA-NEPAD. In 2017-22, TIBA generated almost £3M funding for research, training and community engagement beyond the core NIHR award. Several TIBA partners are now funded in-country, e.g. for serological and sequencing studies of SARS-CoV-2.

We note that TIBA's SARS-CoV-2 genome sequencing work was used as an Impact Case Study in NIHR's submission to DHSC for renewed GHR programme (see Supporting Documents). We are delighted to have made such an important contribution to the sustainability of the GHR programme as a whole, while acknowledging the irony that TIBA itself was not awarded any further funding.

Though the COVID-19 pandemic was not predictable as a specific event, TIBA's capacity to respond arose directly from our pre-planned Epidemic Preparedness strategy (WP6). TIBA had already provided training and local capacity strengthening in genome sequencing and data analytics precisely because consultations with our partners had indicated that these were core capacities that would be needed locally during a pandemic. This laid the foundation for our highly successful and very visible pandemic response work. As an example, TIBA Botswana received several unanticipated benefits from their involvement in TIBA's WP6: establishing new partnerships through the Africa COVID-19 Genomics Collaborative network; receiving £21K funding from FCDO as well as support from the Botswana government; and producing a video to tell the story behind the COVID-19 response using

whole genome sequencing that was released during the 2021 World Science Day.

Describe any successes in securing related funding

Over the project timeline, TIBA secured additional direct funding up to £2,814,051. In addition, our collaborators in Ghana and Kenya have used their TIBA membership to leverage £9,891,050 additional funding up to 2024 to support research and capacity building projects. Full details of all related funding are appended as an Upload.

The additional funds have supported programmes such as the following:

- 1) Training and workshops including: (i) 'Towards an Integrated African Vaccine Policy' in collaboration with the African Vaccine Manufactures Initiative (AVMI) and AUDA-NEPAD, held in South Africa, July 2019; (ii) Advancing innovative, evidence-informed, demand-driven and policy-relevant research for strengthening health systems and improving patient outcomes in Africa through capacity building in evidence synthesis, held in Ghana, May 2019; (iii) Strategic Use of Innovation and Intellectual Property to Move Africa towards a Knowledge-Based Economy, held in South Africa, March 2019.
- 2) Research: Supporting nine additional Out of Africa Fellowships through our collaboration with the African Academy of Sciences, two of whom were from non-TIBA countries (Nigeria and Egypt).
- 3) Community engagement and Involvement: A workshop on Community Engagement and Involvement held virtually in April 2020.
- 4) Travel: Costs for TIBA partners to collaborate with Edinburgh researchers and others and for students to attend general meetings and conferences.

The activities supported by these additional funds are all directly relevant to the overall objectives of the TIBA partnership. In line with TIBA's policy, at least 80% of these funds have been for activities in LMICs.

Over the course of the 10-month no-cost extension, we were only able to continue TIBA activities, our programme of work and the delivery of impact because of the University of Edinburgh and all our partner institutions' willingness to underwrite some of our ongoing operational costs, including staff salaries and research costs.

The University of Edinburgh provided in-kind support with a £150K bridging funds to cover the no cost extension to TIBA, covering salaries for the Programme Manager and secretarial support.

To continue our work in Africa – including TIBA's contribution to the national and international response to the COVID-19 pandemic – we relied on in-kind support from our African partners. Our partners have also been asked to complete onerous and labour-intensive administrative tasks outwith their period of funding, using their own resources that had to be diverted from other tasks, including their own pandemic response work.

In effect, our African partners were subsidising TIBA over this period rather than being supported by NIHR funding.

Outputs

We have disseminated TIBA's findings through presentations, publications, community engagements, policy briefs and the media. We achieved impact by working closely with communities, policy makers, national governments, the AAS, WHO AFRO, WHO's NTD programme, and AUDA-NEPAD.

Project outputs in the past year include:

- BMGF recommended TIBA to help ICGEB produce an online learning module for health workers in Africa deploying COVID-19 rapid diagnostics.
- We held ten virtual research seminars, one per partner country, plus virtual events for our postgraduate and Out-of-Africa Fellows.
- Our postgraduate students and Fellows submitted a further 20 meeting abstracts.
- We continued to work with WHO AFRO on genomic and epidemiological analyses of SARS-CoV-2.
- TIBA helped train 16 NEPAD officials and representatives of the African Regional Economics Groups on health-related IP knowledge and skills at a workshop in Cape Town, South Africa.
- Of our 97 publications to date, 60 have been produced since our last annual report.
- We continue to engage the wider scientific and non-scientific audience via our website and social media platforms. As of 18/03/22 the TIBA website had had 18,334 visitors with 64,649 unique page views (see Upload). Our Twitter account has 1588 followers.
- TIBA contributed to a WHO policy brief promoting deworming adolescent girls and women of reproductive age.
- TIBA was involved in the evidence synthesis for new WHO guidelines on schistosomiasis control and elimination launched in February 2022.
- TIBA Botswana produced a video of TIBA's genomic sequencing work and its impact on the national response to the COVID-19 that was used by the FCDO during the World Science Day in November 2021.
- Our partners contributed 21 policy briefs related to COVID-19, e.g. diagnosis of frontline health workers (Zimbabwe); seroprevalence studies (Ghana); health and socio-economic impacts of physical distancing (Kenya).
- There have been over 40 in-country press coverages of TIBA activities.
- Through TIBA, the University of Edinburgh created new research and training links with the African Research Universities Alliance and the African Centre for Global Health and Social Transformation.

We highlight three TIBA outputs that have had significant global impact.

1. Details of TIBA's COVID-19 pandemic response work are freely available on our web site. Key outputs include: 4 reports on diagnostics; 5 reports on capacity building; 3 guides to resources; 3 reports on genome sequence data; 2 analyses of national responses with links to TIBA-generated open access data sources; 100 weekly situation reports based on WHO data, now produced by the Center for Epidemiological Modelling and Analysis in Nairobi (a demonstration of our core aim of shifting the centre of African research to Africa). These outputs have directly informed policy and practice by national governments and WHO AFRO.
2. TIBA helped develop the AUDA-NEPAD 'Health Research and Innovation Strategy for Africa (HRISA) 2020-2030', formally adopted by AU member countries in 2019 and now being implemented across African Union member countries thereby shaping national health research and innovation strategies across the continent.
3. TIBA collaborated with the WHO AFRO and EDCTP to assess 'National Health Research Systems in the WHO African Region' in 2018 leading to the development of a strategy for addressing weaknesses (see Impact)

Progress with activities related to technology development

TIBA collaborators in Botswana have developed an eHealth platform for data capturing and monitoring of NTDs. This has been piloted in the Chobe district which has one of the highest burdens of NTDs, particularly schistosomiasis and soil transmitted helminths. The success of the pilot has led to a roll out of the platform to other districts to enable the Ministry of Health and Wellness to have active surveillance for all NTDs in the country and provide guidance for elimination efforts.

TIBA Ghana is engaged in the development and production of multiplex array card for early detection of acute febrile illness in children aged 1-15 years in Ghana.

Ghana has also generated monoclonal antibodies for three malaria antigens which have shown to be essential and critical for the process of merozoites invasion. These have been successfully expressed in HEK293 cells and purified to homogeneity. Nine genes and three previously characterized merozoites antigens were expressed as recombinant protein. The proteins were all verified using a Liquid Chromatography MS/MS platform.

Ghana is developing an ultrasensitive diagnostic tool for non-falciparum parasites. This required developing both PCR-based methods as well as Chip-based biosensor. Validation is under way.

Kenya is working on developing monoclonal antibodies targeting Plasmodium falciparum variant surface antigens (VSA), with the aim of applying these antibodies as vaccines or therapeutic agents against malaria. The first objective which has been completed was to identify individuals with cross-reactive anti-VSA antibodies. This is being followed up by antibody functional assays to identify the individuals who not only have cross reactive antibodies, but also have functional antibodies which can inhibit the interaction between the falciparum VSAs and the host endothelial receptors.

Kenya have also trained teams from KEMRI-CVR and National Public Health Laboratory on portable sequencing with support and collaboration from the ARTIC Network and Africa CDC. They have supported additional teams including TIBA collaborators in Botswana and Rwanda.

Rwanda is developing a Big Data Software Platform which would be designed to specifically address challenges and concerns relating to malaria surveillance in Rwanda and more broadly throughout Africa. A range of marketing and training material associated to this platform is planned, as well as potentially some branding (i.e. trademark assets).

South Africa have modified an existing software platform (KoboCollect) which they use for data collection. They are currently working on an app-based data collection tool.

Zimbabwe is supporting a Merck KGaA-led clinical trial of a new child-friendly formulation of the anthelmintic drug praziquantel.

Edinburgh, Ghana, Sudan and Zimbabwe have developed a chip for the detection of infectious diseases as part of the Making a Difference project. This is based on a technology developed by our industry partner PEPperPRINT.

TIBA maintains an IP asset register which is updated annually through an IP audit. As of the completion of the TIBA programme, a grand total of 160 IP assets have been identified and included on the TIBA IP asset register. Most are considered foreground IP assets which TIBA collaborators have developed under NIHR funding. A full breakdown of the various types of IP assets used or developed under TIBA is provided as a Supporting Document.

Community Engagement and Involvement

All TIBA projects fell within the remit of 'applied global health research'. The bulk of the research was done in LMIC settings and involved affected populations. Work done in Edinburgh directly supported TIBA partners' priorities and the professional development of African researchers.

Our CEI methodology involved a package of different approaches informed by our experiences and literature. Patient and public involvement provided valuable insights before, during and after projects were undertaken. In addressing local research needs, TIBA built a framework to achieve the two core components of inclusion: representation and giving voice. All TIBA projects were required to have a locally relevant community engagement strategy that were assessed as part of our project review process.

We used a suite of mixed methods including but not limited to dialogue approaches and creative placemaking. Sudan, Uganda, South Africa and Zimbabwe all used theatre as a means of community engagement. Ghana used art and docudramas to give voice to under-empowered stakeholders (women where there are gender stereotypes, youth where gerontocracy is the norm, disability where stigmatisation occurs). We incorporated annual community activities and feedback meetings in several of our projects. We continuously engaged with communities and consulted them to determine their preferred methods for communicating research outcomes.

TIBA's takes a "we leave no-one behind" approach to inclusivity. This is well illustrated by TIBA Zimbabwe's Rapid Impact project which has improved access of pre-school children to treatment for schistosome infection, previously denied to them by the standard school-based mass drug administration (MDA) programmes.

Many of TIBA's projects focussed on women (including pregnant women) and children (both school-aged and pre-school). Schools were often used as an engagement point (e.g. projects on schistosomiasis in South Africa, Botswana and Zimbabwe). TIBA partners undertook projects in both rural and urban settings; Sudan and Uganda also worked in refugee camps.

An example of a project developed with extensive community input was the South Africa-led Making a Difference project: Understanding schistosomiasis among children under five years. While there was schistosomiasis baseline information on school-aged children in South Africa there was minimal data on pre-school-aged children (PSAC). The project gathered information from KwaZulu-Natal Province to provide evidence for inclusion of PSAC in the developing national strategy for MDA. As this project was a multi-country collaboration, South Africa was able to learn from many years of experience of similar MDA programmes in Rwanda and Zimbabwe.

Our CEI Lead (Prof. Moses Chimbari) led a 3-day CEI workshop in April 2021 which benefitted over 30 participants. The workshop aimed to provide a forum for TIBA partners to share processes and outcomes of CEI activities and learn from each other. Outcomes of the workshop were capacity strengthening through enhanced CEI skills and policy and/or practice outcomes through developing a comprehensive implementation plans for CEI activities linked to in-country projects, focusing on dissemination of research outputs and knowledge uptake.

Our partners continue to disseminate the outputs of their work to their communities and stakeholders. We note that the NIHR has adopted portions of TIBA's CEI plans for the wider GHR programme.

Engagement with Partners and Stakeholders

TIBA subscribes to the 'Eleven Principles of Transboundary Research Partnerships' developed by the Swiss Commission for Research Partnerships with Developing Countries.

Each Africa partner identified national stakeholders who they engaged with throughout the life of the project. Funding was allocated for regular in-country stakeholders' meetings involving other local researchers, government, community representatives, local FCDO and WHO offices and NGOs. Outputs of these meetings fed into priority setting and study design.

Cross-partner working was integral to the Making a Difference projects and new collaborations between TIBA partners were initiated with other funding, e.g. EDCTP-funded East African Centre of Excellence network.

We worked with four industry partners: African Vaccine Manufacturing Initiative (AVMI), AVIA-GIS,

Merck, and PEPperPrint who were involved in specific research projects and contributed to meetings and training activities.

We engaged with the African Regional Intellectual Property Organization (ARIPO) to deliver an IP training manual for the Regional Economic Groups in Africa.

TIBA partners in Ghana and Kenya are engaged NIHR GHR groups working on Plasmodium drug resistance surveillance and on virus genetics and bioinformatics respectively. Fogarty International Center, Oxford Nanopore and the ARTIC network supported sequencing and bioinformatics analysis of SARS-CoV-2 sequencing work in Kenya and Rwanda.

TIBA achieved impact by working closely with multiple stakeholders: communities, national governments, the African Academy of Sciences, WHO AFRO, WHO's NTD programme, and AUDA-NEPAD.

TIBA contributed to the Africa-wide response to the COVID-19 pandemic through our engagement with WHO AFRO at Regional Director level, including media and press briefings. COVID-19 sequencing outputs from TIBA partner institutions in Botswana, Ghana, Kenya, Sudan and Rwanda fed into national government policies and approaches to managing their response to the pandemic. This output can be traced back to the TIBA/ARTIC genomic sequencing capacity building workshop in Ghana in 2018. The results have been uploaded to the open access platform GISAID to be available other researchers and informing global surveillance of SARS-CoV-2 variants. TIBA's analyses of African sequence data are freely available on our web site. This work was submitted as a case-study to the NIHR as part of the UK Government's Comprehensive Spending Review.

We partnered with Uniting to Combat NTDs by providing NTD awareness materials for health education and advocacy.

Our WHO AFRO partners have completed the follow up work on the National Health Research Strengthening in member countries. We have assisted WHO AFRO's health systems cluster by leading the assessment of WHO AFRO member countries' health research systems scoring them on a barometer. Our analysis was presented to ministers of health at the 68th Regional Meeting of the WHO AFRO member countries, and we are now collaborating with WHO AFRO and EDCTP to formulate a roadmap to help member countries develop strategies to address weaknesses identified in their health research systems.

TIBA supported the WHO Africa Region's pandemic response by reporting on COVID-19 testing activities, mitigation measures and SARS-CoV-2 genome sequencing. At the request of WHO AFRO, we provide a weekly COVID-19 situational report for the individual epidemic for every WHO AFRO member country.

TIBA made a significant contribution to the 2021-2030 NTD Roadmap which was part of the Kigali declaration and was an energetic participant in the World NTD Day in January 2021 and 2022.

TIBA provided technical experts to help AUDA-NEPAD develop the Health Research and Innovation Strategy for Africa (HRISA 2020-2030). On the impact side, this strategy to deliver the health and innovation research agenda for the African Union's Agenda 2063 and was formally adopted by health ministers in African Union member countries in 2019. We are continuing to work with AUDA-NEPAD to operationalise this strategy.

TIBA has continued to be Africa-led, applying our expertise to current and important health challenges in the partner countries or African continent. This has ensured that TIBA is answering questions relevant to each country's health needs. Our engagement strategy at national level has ensured buy-in from ministries of health and development partners ensuring local ownership and sustainability. For example, our partners in Zimbabwe, Rwanda, South Africa and Botswana have been answering questions on how to access young children for schistosomiasis in their respective health systems. Findings from this study have informed ministries of health in these and other countries on how to design the control strategy for the disease to include this young group currently excluded from national schistosomiasis control programmes.

Gender and Vulnerable Groups

TIBA works in accordance with the Transformation Agenda of the World Health Organization Secretariat in the African Region (2015-2020). In addition, all our work packages fall under the umbrella of the Sustainable Development Goals (SDG) including SDG 5, Gender Equality. A thematic TIBA principle is that "we leave no-one behind".

All TIBA's programmes assure that equity is being achieved through the use of explicit gender indicators as part of our MEL framework, specifically: "TIBA projects are monitored for and report on their contributions to gender equality and the empowerment of female scientists"; and "TIBA projects are monitored for and report on any contributions to the equality and empowerment of people with disabilities internally within the programme".

For example, the compositions of our Directorate, Steering Committee, External Advisory Group membership, Principal Investigators in partner countries, postgraduate students and staff all demonstrate our commitment to gender equality in the delivery of our work and its output. 51% of our 33 NIHR Academy members were female.

The 13 peer-reviewed publications (see Section 1.4.1 on 'Approach to Project Outputs') generated from TIBA's research having LMIC female last authors exceeds the total number of such papers reported by all other NIHR GHR Units combined. Similarly, the 25 publications with LMIC first authors exceeds the total from all the other Units. We note that first and last authorship is an important criterion for academic career progression and for external recognition.

In addition, for one of our 'Making a Difference' projects, our partners in Uganda developed novel diagnostics and surveillance systems to detect symptomatic and asymptomatic cases of the gambiense form of human sleeping sickness among South Sudanese refugee populations living in northern Uganda. This project was aimed at exploring the wider social and environmental conditions that contribute to infection burden in this highly disadvantaged and vulnerable population. This is evidence of our commitment to "leave no one behind".

Individual training and capacity-strengthening activities

Our named Training Leads (Prof. Awandare, Ghana, and Prof. Kinyanjui, Kenya) had oversight of TIBA's training activities, mentorship and post-award support.

Our training programme aimed to develop research leaders capable of carrying out high quality research, define their research agenda, attract funding, advocate for health research and evidence-based policies, and feed into teaching, practice and health management. We used a combination of 'In-Africa' and 'Out-of-Africa' training models that resulted in the development of a cadre of research scientists and health professionals equipped with the skills necessary to tackle the challenges of infectious diseases and epidemic preparedness.

TIBA's 'In-Africa' postgraduate training programme had 33 students (20 PhD and 13 MSc/MPH) registered across the nine partner countries. All students completed their studies and graduated – details are appended as Supporting Document (NIHR Academy Members). Basing all TIBA's PhD students in African universities ensured local ownership of the training programme and strengthened the home institute's research and training environment for both students and staff.

TIBA's 13 Out-of-Africa fellows each spent 3-10 months working in Edinburgh, benefitting infectious disease research teams in the UK. A further 9 fellows from five African countries (Ghana, Egypt, Kenya, Nigeria and Zimbabwe) were enrolled in supplementary programme funded by the University of Edinburgh, arising from an MOU with the AAS signed in 2019. This extended the Out-of-Africa Fellowship programme to all AAS member countries. The scheme was administered by the AAS and fellows were hosted by TIBA while working with collaborators within Edinburgh's centres of excellence. Overall, there was 100% retention/employment of fellows in substantive research posts in African research institutes. All our fellows published at least one scientific paper acknowledging

TIBA/NIHR support. The fellows were supported throughout by capacity building and career support activities.

TIBA has continued with academic training of researchers and practitioners in Africa. Our demand-led interactive, in-person workshops were very popular and effective. Our 13 informal trainings and workshops benefitted 648 scientists and other research staff from 25 African countries as well as other NIHR GHR partners from Bangladesh, Pakistan, India and Malaysia. Topics covered were: Ethics in Health Research; Malaria Diagnosis; Use of Innovation and Intellectual Property; Real-time Genome Sequencing; Peptide Microarray Development; Data Management; Missing Data; Evidence-based Synthesis; African Vaccine Policy; Good Financial Grant Practice; Monitoring, Evaluation and Learning; Data Science; and Community Engagement and Involvement.

Our training event in Rwanda introduced the Global Grant Community's system of GFGP accreditation to 80 research managers from TIBA and 8 other GHR Units. Following this workshop, 6 TIBA partners are aiming for certification. Finance managers from Rwanda and Kenya visited Edinburgh to be familiarised with new grant management systems set up through a FAF award.

Three of our informal trainings - on Missing Data, MEL, and CEI - were held virtually in 2021 due to the pandemic.

All TIBA capacity building activities adhere to the "7 principles for strengthening research capacity in LMICs" (ESSENCE, 2014). We recommended these guidelines to other GHR Unit training leads.

Institutional Capacity Strengthening

We have supported our partners with computing facilities, laboratory equipment and consumables to build in-country infrastructure, capability and research capacity.

Each TIBA project had an itemised budget specifying planned spend on non-staff research infrastructure. This was done for all the approved Rapid Impact, Postgraduate Student, Making a Difference and Data Science project proposals. For example, TIBA Kenya used part of their core budget to revamp their data centre with 50 new computers - see Asset Register.

The University of Edinburgh also purchased computer hardware and software to support the work of the Out of Africa Fellows during their time in the UK. These purchases are also included in the Asset Register.

We communicated the NIHR's definition of assets to our partners and asked them to provide a written undertaking that they will self-report any loss, damage or decommissioning of assets as the NIHR defines them. We undertook sporadic checks on partner assets, and we obtained quarterly updates as part of the quarterly financial reporting. There was no report of losses, damages or decommissioning of any asset during the project's lifetime. All assets would therefore continue to be used to support ongoing global health research in partner institutions as part of our sustainability plan. The Asset Register and Disposal Plan is appended as an Upload.

As part of WP2 Making a Difference project on 'Developing and evaluating a comprehensive multiplex peptide array serological diagnostic for use in Africa', the PEPperPRINT platform developed in Edinburgh was extended to Ghana, Sudan and Zimbabwe who were joint partners on this project. We subsequently purchased Innopsys Innoscan 710 Microarray Scanners and RT-PCR systems for delivery to Botswana, Ghana and Sudan. Furthermore, both in-Edinburgh and virtual training have been offered to the users in these two countries. This equipment has ensured that the three countries are able to print their chips locally and have the capacity to measure expression levels of genes associated with diseases that are of national interest in order to understand the epidemiology and molecular basis of those diseases.

During the AGM in Accra, Ghana (September 2019), an IP support desk was created to provide a one-on-one advice and support to our partners.

As part of strengthening Africa's epidemic preparedness, and building on our 2018 genomic sequencing training, in March 2020 TIBA equipped partner countries with funding, sequencing platforms, equipment and laboratory consumables to support in-country generation of SARS CoV-2 genome sequence data that is informing their national responses to the Covid-19 pandemic. This TIBA-facilitated capacity has been nationalised with additional government/stakeholder funding in some countries leaving a legacy for future national responses to disease outbreaks and epidemics. As of 10/02/22, five TIBA partner institutions in Africa have generated a combined total of 12,386 (14.7%) of the 83,851 SARS-CoV-2 genome sequence from Africa (Botswana 3083, Ghana 2424, Kenya 5859, Rwanda 728 and Sudan 292) thanks to TIBA's genome sequencing capacity building initiative. TIBA is delighted with this output and its in-country impact. In keeping with our open access policy, all these sequences have been uploaded on the GISAID (Global Initiative on Sharing Avian Influenza Data) platform for other researchers to use.

Major/Significant Changes

In 2017, the Principal Investigator of TIBA Tanzania, Dr Mwingira, left the National Institute for Medical Research in Tanzania and ceased to be a TIBA Co-investigator. She was replaced by Dr Kazyoba.

We reported in 2019 on TIBA-Sudan PI's relocation from the Institute of Endemic Diseases, University of Khartoum to the Ibn Sina University, Khartoum. All formal processes related to this were duly completed. We formally assessed any implications for project milestones and deliverables and found nothing that should impede the delivery of project outputs.

We also reported in 2019 that we had been forced to postpone the TIBA-Sudan Out-of-Africa Fellowship due to the refusal of UK Visas and Immigration to grant a visa to the approved Fellow, despite University of Edinburgh sponsorship. We explored alternative routes and the Fellow was finally able to visit Edinburgh to undertake and complete his fellowship.

We reported in 2019 difficulties in transferring funds to WHO AFRO for a key TIBA Toolkit project on systems research capacity in sub-Saharan Africa. This issue was resolved with no negative impact on the delivery of the project.

In 2020, two WP6 real-time genome sequencing projects were re-purposed to SARS-CoV-2. Those projects were on the use of real time genomics for investigating i) rotavirus outbreaks in Botswana and ii) measles virus outbreaks in Rwanda. As part of next steps, our partners intend to use their sequencing capacity to revisit these projects.

As part of our WP6 on Emergency Preparedness and in collaboration with WHO AFRO, we developed new strands of activity relating to the COVID-19 pandemic in Africa: supporting SARS-CoV-2 genome sequencing in four partner countries; capacity building; COVID-19 mitigation and testing reports; weekly COVID-19 situation report for the WHO AFRO region, and SARS-CoV-2 genome reports among others. These are detailed on our website.

Challenges Faced and Lessons Learned

Challenges and lessons learned were discussed at Directorate and Steering Committee meetings. The responses below are also informed by invited feedback in the final reports of completed TIBA projects.

Project Management. The administrative burden placed on GHR Units was a continual challenge, absorbing a significant proportion of TIBA resources and a very high proportion of staff time.

Our independent End of Term Review concluded that TIBA experienced several challenges in terms of delivery effectiveness, such as multi-country communication and community engagement difficulties, but where appropriate the TIBA leadership has demonstrated an ability to respond to these challenges and provide additional support where required (e.g. the CEI training).

Research. We conducted a survey of the likely impact of the COVID-19 pandemic on our partners in March 2020. Research activities were interrupted in all nine partner countries due to government restrictions. This was especially problematic for our four Making a Difference projects (WP2), all of which involved laboratory and/or field work.

Our flagship Out of Africa Fellowship programme was affected by COVID-19 by preventing travel to the UK. However, all fellows have now completed their projects and all but four of our fellows (all AAS- not NIHR-sponsored) were able to visit Edinburgh. We note a consensus among all Out-of-Africa fellows that the one-year time frame was too short.

Partner management. Our partners' commitment to and enthusiasm for TIBA's work has been outstanding throughout. By far the biggest management issue was keeping up with the funder's administrative demands. TIBA's philosophy was to use the TIBA secretariat and the UoE finance office and subcontractors to minimize the load placed on our partners. This approach was very well received but the administrative burden on our partners remained substantial. The demands by the funders for administrative information grew over time, culminating in the full financial audit, but were met without complaint, despite the significant strain on finances and especially on time budgets.

When asked about challenges at part of End of Programme Review, 100% of TIBA partner respondents said "Covid-19" either had a "significant" or "very significant" impact on their projects (see above). For "time related pressures" this was the case for 44% of the respondents, respectively. For "lack of capacity" the figure was also 44%. Finally, a "lack of internal engagement" was reported again by 33% TIBA partners to be either very significant or significant.

External engagement. This is described fully elsewhere (see Impact). "Lack of external engagement" was reported by only one of our partners as being significant to their project.

Producing research outputs. We faced an initial challenge of failure of partners to include an acknowledgements statement on publications and/or failing to notify the TIBA Secretariat of publications in advance. This improved during the course of the programme.

Achieving key outcomes and impacts. COVID-19 significantly delayed outputs of TIBA's Work Packages 2 to 6 (Making a Difference projects, Toolkit projects, Capacity Building, Dissemination for Action and Emergency Preparedness). NIHR were informed in the 2020 Q4 Financial Report. We initiated discussion with NIHR to request an extension up to January 2022 that compensated for these challenges, although the absence of additional NIHR funding meant that our African partners used their own resources to deliver their outputs, thus subsidizing TIBA's activities during this period.

Communicating findings. We had hoped that TIBA researchers – especially early career researchers – would have the opportunity to report the outcomes of their research at national and international conferences towards the end of the programme. This is an important career development activity but there were minimal such opportunities due to the pandemic. We also had to cancel plans for a final AGM. We did, however, organise a series of virtual seminars, nine in total. Each TIBA partner country presented their own work at one session. In addition, we devoted a full day to hearing from the Out-of-Africa Fellows and another to hearing from the TIBA PhD student community. These seminars were very well received.

Our End of Programme Review includes a section on Lessons Learned and Recommendations that will be valuable for TIBA's future activities (see Supporting Documents).

Finance

As proposed in the TIBA Annual Report 2019, Collaborator payment/invoice dates were re-aligned to be issued at the same time as quarterly financial reports. This adjustment allowed TIBA to more accurately track levels of funding held by Collaborators during annual reporting periods. Previously, payments were processed ahead of reporting which distorted fund levels held by Collaborators at reporting stage. Once the funds held by a Collaborator fall below that of the level of their next payment amount, an invoice can be forwarded for processing. Where a Collaborator had highlighted

that a quarterly period is likely to have a higher spend level than that of the combined funds held and being processed in their current invoice, they had the option to submit an interim spend report which could be reviewed, and an additional payment made as a “top-up” to keep them cash positive (subject to approval by the TIBA Directorate).

Overall funding per Collaborator and Project Payment amounts were adjusted as new Projects, such as Data Science projects, Out of Africa Fellowships, etc. were approved to each Collaborator’s portfolio of Projects under the TIBA Partnership. Due to each Collaborator having their own unique payment values depending on their TIBA projects, the levels of “surplus” funds held in their accounts were individually monitored to ensure they were never above the value of their next payment. TIBA continued to make payments to suppliers, with goods delivered directly to Collaborators where necessary in order to minimise delays which a Collaborator would experience should they place the order themselves. This was then deducted from the Collaborator’s next payment amount. This process was used regularly with our Collaborator in Sudan (Ibn Sina University) where the movement of money in and out of the country was more restrictive. Payments to Ibn Sina were subsequently being sent with minimal issues.

During the COVID-19 pandemic, it became necessary to purchase laboratory consumables directly for our Collaborators in Botswana, Ghana, Rwanda, Sudan and Zimbabwe to facilitate their research.

In late 2018, we entered into an agreement with the WHO-Africa Region to undertake TIBA research entitled ‘Strengthening the national health research systems of WHO Member States in the African Region’ as part of our Tool Kit project. The approved budget was £62,000. TIBA believed that this potential collaboration would be very useful and in line with its remit of engaging continental health policy stakeholders. Contractually, the University of Edinburgh had some difficulty in getting WHO to agree to its standard Collaboration Agreement wording which also took into account NIHR funding terms and conditions. In order to resolve this and progress the work, we agreed to use WHO’s draft agreement and made very light changes to it to ensure that NIHR requirements were met. Some of these challenges included, for example, WHO unwillingness to assign copyright over to any Project reports, so that the University can in turn assign them to the Authority; WHO not agreeing to the standard provisions relating to foreground IP, Patient Benefit and a license to the University for them same. They did point out that as a UN agency they must make health related products accessible to the public sector in developing countries as classified by the UN. Furthermore, the licence they were willing to provide to the University was restricted to academic purposes. In spite of all the challenges, an agreement was finally reached, and the WHO AFRO region successfully delivered on the project. At the Grand Challenges Meeting in Ethiopia in 2019, the WHO AFRO Regional Director, Dr Matshidiso Moeti, thanked TIBA for collaborative work on the health systems barometer. This collaboration has extended beyond the initial project with TIBA heavily involved in supporting improving resilience of African health systems to epidemic or pandemic shocks in relation with our work with WHO AFRO on COVID-19.

In early 2019, the Principal Investigator of TIBA Sudan, University of Khartoum (UoK), Prof. Maowia Mukhtar and his research team moved to a new institution, Ibn Sina University, also in Sudan. Following that, and in accordance with NIHR guidelines, we requested for a ‘change to programme’ as the entire TIBA Sudan team and all purchased equipment and supplies had already moved to Ibn Sina University. We followed the contractual obligations within the Framework Collaboration Agreement (FCA) and terminated our agreement with the University of Khartoum. We then undertook both financial and ethical due diligence for Ibn Sina University. Once all the necessary processes had been completed, we replaced our existing FCA with the UoK with a near identical agreement with Ibn Sina University in order for Prof. Mukhtar and his team to conclude the delivery on the TIBA programme of work in Sudan. The change was only about the institutions involved. There was no change to the programme of work in Sudan, though we had anticipated that delivery could be delayed due to the time it might take to complete the paperwork. This was not the case.

The biggest financial challenge faced by TIBA was the 10-month no-cost extension at the end of the award to end January 2022. The option to extend was well-received as both the Director and many of our partners were heavily involved in the national and international response to the COVID-19 pandemic. However, although we had been given to understand that additional funding was available under the heading of ‘Emergency Response’, in the event no extra funding was made available.

Consequently, TIBA's work during the no-cost extension was heavily subsidized by both UoE and by our partner institutes. Some of our COVID-19 response work was funded from the remaining WP6 budget (permission having been granted by NIHR for this re-direction of effort), but this too was heavily subsidized by UoE and partners. From the NIHR perspective this represents tremendous value for money, but it is noteworthy that some of the TIBA outputs that NIHR has highlighted in their own communications (e.g. SARS-CoV-2 genome sequencing work) were only possible because our African partner institutes were providing financial support for TIBA activities during this period.

TIBA had an underspend of £98,370.92 as of 31 January 2022 (contract end date). The main reason for this was our inability to hold our final partnership meeting originally scheduled for Kenya in 2020 but first postponed and eventually cancelled due to travel restrictions. We intend to use these funds to support: i) publication, conference attendance and community engagement, especially by early career African researchers; ii) dissemination events to showcase the impact of TIBA's work (see Next Steps); iii) preparation of policy briefs.

Value for Money

TIBA continued to ensure compliance with ODA requirements by achieving value for money (VfM) through our approach to project selection, management and reporting and through regular evaluation. Compliance was independently verified by our MEL providers. VfM was evident in the response of all our partners to the 2020/21 NIHR finance audit for FY2019/20.

We used the 4E's framework for evaluating VfM and note that this was shared with NIHR and adopted by the entire GHR programme.

Economy.

The Steering Committee assessed VfM when reviewing project proposals. For example, the South African-led Making a Difference project was rewritten to ensure VfM before it was finally approved.

TIBA followed UoE's procurement strategy, which is aligned to the Scottish procurement reform and commercial improvement programme, under which UoE is independently assessed every two years. Our partners adhered to local institutional procurement laws. All capital expenditure was captured and recorded in our Asset Register and shared annually with the funders.

Our partner institutions in Ghana and Kenya have gold tier good financial grant practice (GFGP) certification, and Zimbabwe has a silver tier.

Efficiency and Effectiveness.

We converted inputs into outputs in the form of academic peer reviewed publications, training courses and strategic documents for WHO-AFRO and AUDA-NEPAD. We also engaged communities where our research was conducted in order to communicate the findings in ways that benefited these communities. Working in partnerships added greatly to TIBA's ability to achieve VfM.

Equity.

TIBA project proposals were targeted at populations based on health priorities of partner countries and WHO-AFRO and the African Union. All project applications required partners to demonstrate a strong link to the Sustainable Development Goals. Our aim of ensuring that more than 80% of funds were spent in Africa was achieved. This has been possible due to the University of Edinburgh's relatively low overheads charged on the grant.

PIs and stakeholders consulted as part of the Mid- and End of Programme Review emphasised the positive impact of TIBA's flexible and responsive financial management systems. Limits to cash flow were a common constraint on partner's capacity to fully engage in research programmes. UoE therefore decided to make 3-month advance payments to partners, thus minimising the financial burden placed on partners whilst managing any risk to UoE. This enabled research institutions with

more limited financial capacity to deliver project outputs on time.

The biggest threat to VfM was the enormous administrative/reporting burden imposed by the funders. The financial cost was considerable (approx. 20% of costed funding) but an even bigger issue was time costs. Project administration took up a large fraction of PIs and Co-I's time allocation (almost 100% for the Director), leaving little for core activities. For some partners the net impact of the programme on net research outputs was probably negative, by taking time from research activities.

Governance, Monitoring and Evaluation

Governance and oversight were the responsibility of the Directorate, Steering Committee (SC), Work Package (WP) leads and External Advisory Group (EAG).

The Directorate comprised the Director and two Deputy Directors and had primary responsibility for delivering TIBA's goals. The Director was supported by a dedicated Project Manager.

SC Terms of Reference were to have oversight of project management and to review and approve all TIBA research projects. The SC met twice a year, in person at project meetings, otherwise virtually. The Directorate regularly consulted the SC on operational issues – including risk management – as they arose.

Delivery of individual research projects (WPs 1 & 2) was the responsibility of the project lead. Project applications and outputs were reviewed in depth by the SC. Site and subject selection, inclusion/exclusion criteria, sample sizes, data to be collected and data analysis plans were set out in each project proposal. The SC provided technical support for, and input into, project development where necessary.

The Co-Leads of WPs 3-6 were responsible for co-ordination and reporting of WP activities.

Our External Advisory Group (EAG) provided an independent perspective on progress and advice on TIBA's future. Terms of Reference were: to refine, ratify and support TIBA's purpose, aims and objectives; provide high level overview of progress against performance indicators and stakeholder expectations; help raise TIBA's profile among donor, industry and global health communities; and advise on sustainability and funding sources.

The EAG, SC, all TIBA members, researchers and students and stakeholders attended two full project meetings in South Africa in 2018 and in Ghana in 2019.

Responsibility for MEL was divided between internal TIBA lessons learned activities (part of WP3) and our independent MEL provider, LTSI. Lesson learned exercises were conducted for our Rapid Impact projects, Out-of-Africa Fellowship programme and data science projects and published on our web site. We used the Health Policy and System Research framework to show how the Rapid Impact projects built interdisciplinary health research capacity. This exercise informed and guided the design of the data science projects.

In late 2019, LTSI conducted a Mid Term Review (MTR) of TIBA's programme of work (see 2020 annual report). The review recommended rigorous data Quality Assurance ahead of subsequent NIHR annual reports and the End of Programme Review. It also developed a revised Theory of Change and MEL framework to better connect to TIBA delivery and created a foundation on which further work could be done to enhance consistency and data quality across TIBA's portfolio of work.

A MEL support desk was provided during the 2019 Ghana AGM offering one-on-one advice/support to TIBA partners. In July 2020, LTSI facilitated 10 hrs online MEL training for Fellows and in-country TIBA research teams via interactive sessions covering: impact pathways for 'Research for Development'; building awareness of the TIBA Theory of Change; training on the MEL categories and logic that emerged from the MTR. This guidance improved the quality of data produced by subsequent TIBA projects and the capacity of African partners to plan, deliver, monitor and evaluate impact-oriented global health research.

Between January 2020 and August 2021 LTSI conducted an End of Programme Review. A copy of the report is uploaded as a Supporting Document

Managing Risk

TIBA's primary tool for risk management was the Risk Register. The register was reviewed by the Steering Committee as the need arose, and at least annually. It is unchanged since a 2020 review focussing on COVID-19 restrictions and international travel. During the project's lifetime, three risks were assessed as 'High': Supporting Services, Externals and Investigator Team.

Supporting services reflected the concern that we would be unable to meet the funder's very onerous reporting requirements, especially as these changed and grew during the first two years of the project. This was managed by diverting resources from research to administration.

Externals included political instability, civil unrest, financial crises and natural disasters (including pandemics). We note that COVID-19 led to some redirecting of effort by TIBA, but no reduction in net research output. External risks were jointly managed by local PIs and the Directorate and any changes to the programme of work agreed in advance with NIHR.

Investigator team turnover is a normal component of academic endeavour. Effective continuity was ensured by having local co-investigators in place throughout, who may become replacement local PIs subject to approval by the Steering Committee.

The biggest risk to TIBA was the possibility that NIHR would not renew their support (which made up over 70% of our funding during 2017-22). They did not. While a competitive funding call never can nor should be taken for granted, we failed to anticipate that TIBA's track record would carry so little weight in the funding decision. Feedback from NIHR itemised concerns about the breadth and ambition of the programme, likely impact on health systems and resilience, succession planning and mentoring, and delivery of capacity strengthening. Yet these are all areas where TIBA has excelled to date (as detailed in this and previous annual reports). The NIHR gave no indication as to why they anticipated such an abrupt and total reversal in TIBA's fortunes, particularly as in the same feedback they noted our "sustained track record for delivery". We are disappointed that the funding committee's assessment was not challenged at the time, and TIBA had no right of appeal. The lesson learned for TIBA risk management is to diversify our sources of funding and not to rely too heavily on a single funding agency.

The decision not to renew TIBA's NIHR funding had direct impacts on the current programme of work, including the premature departure of key staff to other posts and the cancellation of a planned project-wide meeting to mark the transition between TIBA1 and TIBA2 and to share research and delivery achievements and future plans. Also, not least, there was a severe impact on morale of TIBA researchers and support staff alike.

Our primary tools for financial assurance and preventing fraud were the University of Edinburgh financial due diligence process, independent financial accounting (delivered by Ingentium), NIHR oversight and GFGP accreditation (using the AAS scheme –see 'Project management'). A delivery chain risk map is appended (see Supporting Documents-Delivery Chain Risk Map).

Safeguarding issues were addressed by auditing safeguarding practices in TIBA partner institutes as a precursor to designing a safeguarding due diligence framework and communication of NIHR safeguarding guidance with a specific request to identify any points of departure with practice in partner institutions. Wider concerns about safeguarding in 2019 prompted us to think about safeguarding procedures across the TIBA partnership, as we had already done for financial good practice, asset registers, data management and ethics. All our partners confirmed that safeguarding policies were in place in their institutions. Subsequently, our partners took part in an NIHR administered online survey on "Safeguarding - Preventing and addressing harm in international development research".

We did not identify any significant risk of fraud and corruption. Our robust project monitoring, quarterly financial reporting and financial due diligence processes continue to serve as ways of ensuring good financial grant practice.

TIBA established an ethics due diligence process across all partners and our ethics policy was written into our Collaboration Agreements with partners indicating the Research Ethics Committee (REC) or Institutional Review Board they relied on for ethical review of research proposals. All projects had to pass national/institutional ethics review, noting that some proposed projects involved children and protected groups. The TIBA Ethics and Governance lead independently reviewed project proposals. All project proposals and evidence of ethics approvals were submitted to the relevant University of Edinburgh ethics committee and shared with the NIHR (National Institute for Health Research) before projects commenced.

Data Management

TIBA's data management practices followed published AAS/AESA/AUDA-NEPAD guidance. Key elements were informed participation and consent, governance and benefit-sharing guidelines, developing standard operating procedures (SOPs), use of material transfer agreements for movement of data across borders, mutually agreed terms for benefit sharing, and promotion of African localisation of translation value chains.

Building on our 2019 workshop held at Kilifi, Kenya, designated representatives of each TIBA research project also attended a data management workshop held in Ghana as part of their WP6 Data Science project.

Long term data storage was made available for all TIBA projects through publicly accessible data storage platforms (e.g. ENA, Dryad) or through Edinburgh DataStore. SARS-CoV-2 genome sequences generated by WP6 were uploaded to the GISAID database and thereby made freely available to support the global pandemic response.

Publication or sharing of data was covered by TIBA's existing IP policy, such that each partner retains foreground IP to data generated by their own research but is expected to license data use by other parties as far as possible.

The WP6 Data Science projects addressed a series of data management issues: exploration of large-scale e-health datasets generated by local TIBA partners (Ghana); storage and management of malaria data (Rwanda); eHealth Surveillance System (South Africa); acquiring a high capacity server for data storage and analysis (Sudan); digitalise archived sleeping sickness data to support decision making (Uganda).

One impact case study is the collaborative project between TIBA Botswana and the Botswana Ministry of Health and Wellness. The project funded customization of an Open-Source software (REDCap) to support data management activities for an NTD study. The success of the pilot led to a roll out of the platform to other districts in Botswana to support elimination efforts.

ODA Compliance

TIBA activities were ODA compliant and consistent with UK AID strategic aims. The primary beneficiaries were from Ghana, Kenya, Rwanda, Sudan, Tanzania, Uganda and Zimbabwe. All these countries were on the DAC list of ODA recipients as of 30/03/2022. Partners from Botswana and South Africa enhanced south-south collaboration and support. Our capacity building programmes involved an additional 16 ODA-eligible African countries: Burkina Faso, Cameroon, Congo, Cote d'Ivoire, DRC, Equatorial Guinea, Ethiopia, Egypt, Guinea, Lesotho, Malawi, Namibia, Nigeria, Sierra Leone, South Sudan and Zambia.

Our activities have always remained ODA compliant in that: 1) TIBA's work promotes the welfare and economic development of the countries where our research is undertaken; 2) TIBA's work is designed to address development needs; 3) TIBA's work focuses on developing country problems. TIBA aimed

to tackle poverty-related diseases, so our work contributed to the aims of defeating poverty and improving global prosperity.

All TIBA projects were proposed by our partner countries in line with their national government's priorities on health and other developmental areas. Project application forms specifically asked about relevance: (i) How does your project demonstrate a need for the study at national and international level and how does it contribute to achieving the Sustainable Development Goals or WHO Afro's Universal Health Coverage Agenda? (ii) Identify your stakeholders and name your primary contacts for achieving impact. How will you engage with the stakeholders identified?

All TIBA partners held regular stakeholders' meetings in order to ensure that their work remains closely allied with local, national and international health priorities.

TIBA has ensured compliance with ODA requirements by achieving value for money through our approach to project selection, project management and reporting. This was independently reviewed by our MEL providers.

Next Steps

Outputs from TIBA's funding over the period 2017-2021 are now largely complete as the 10-month no-cost extension gave ample opportunity to finalise almost all planned project deliverables. Our approach to project outputs such as dissemination strategy follows the ESPA model. Internal dissemination is through our project website, in-country workshops, Annual General Meetings and individual project reports. External dissemination comprises national policy briefs, media and social media, conference presentations and peer reviewed publications, and feedback to stakeholders. PIs of individual projects have responsibility for dissemination of the findings of their projects. Work Package leaders have responsibility for disseminating broader outputs. Feedback on progress reports includes questions about timelines for outputs.

Our remaining activity funded by the current award will be dissemination – we have approximately £98K available for dissemination over the next two years. Our dissemination strategy is to enable TIBA's African partners – especially young Africa-based researchers – to raise the profile of the research they conducted using TIBA funding. Currently planned activities include:

- open access charges for still unpublished TIBA research papers acknowledging NIHR support;
- conference attendance by TIBA partners reporting on TIBA-funded activities;
- community engagement to share outcomes with affected populations;
- showcase meeting in Zimbabwe in July 2022 linked to a commissioned special edition of the on-line journal Nature Africa;
- exhibition of TIBA's NTD work at the Commonwealth Heads of State Meeting in June 2022. Uniting to Combat NTDs is arranging the signing of the Kigali Declaration NTDs which will supersede the 2012 London Declaration on NTDs;
- policy briefs for the African Vaccine Manufacturers' Initiative on how to improve vaccine production capacity on the continent and for the Sudanese Ministry of Health on malaria diagnosis.

TIBA currently has several programmes running supported by non-NIHR funding, including the following examples.

On basic scientific research to inform health policy, TIBA Edinburgh and TIBA Zimbabwe are running a collaborative project funded by the Royal Society on paediatric schistosomiasis. This is researching the optimal time in terms of health benefits and operational logistics to treat preschool-aged children (PSAC) aged 2-5 years old for schistosomiasis. This is critical research to support the new WHO guidelines on the control and elimination of schistosomiasis launched this year, which for the first time

includes the recommendation to treat PSAC.

On pandemics and infectious disease epidemics, TIBA continues to release a weekly Covid-19 dashboard for WHO AFRO – this work is now being led from the University of Nairobi, another example of shifting the centre of gravity from the UK to Africa. TIBA Botswana is undertaking SARS-CoV-2 sequencing work funded by FCDO through the University of Edinburgh. TIBA Sudan is identifying and sequencing Dengue, Rift valley, Chikungunya and Yellow fever viruses from recent outbreaks using the equipment procured through TIBA and additional funding from the local Ministry of Higher Education.

To build resilience in health systems, TIBA is working with the International Centre for Genetic Engineering and Biotechnology on a BMGF-funded project to build a training model for health workers in poor resource settings in Africa. This will focus on epidemiology and public surveillance as part of the programme to establish low-cost diagnostics appropriate for community and austere laboratory settings.

TIBA continues to train and support postgraduate and postdoctoral African scientists. For example, Arthur Venegsai, a TIBA Zimbabwe PhD student is now a lecturer at Midlands State University continuing his TIBA-related research with funding from Merck KGA. TIBA Edinburgh will continue to offer at least one African student a fully funded PhD-studentship for the next 5 years under the Wellcome Trust-funded Host Pathogens and Global Health Doctoral programme.

Our longer term plans are set out in detail in TIBA's Sustainability Plan (as an Upload). This programme of work has been delayed due to our failure to secure additional funding from NIHR. New funders are now being sought.

Our External Advisory Group have recommended extending TIBA to other African countries, especially francophone and lusophone. Our major stakeholders are in complete agreement with this strategy. We intend to develop a hub and spoke model for delivering this expansion. This will directly address the issue that countries with a weaker science base risk being left behind by major research programmes.

TIBA aims to continue building research leadership in Africa through four activities: postgraduate training through PhD studentships; post-doctoral training through research fellowships; short courses and industry internships. Furthermore, TIBA will lay a strong emphasis on leadership training through mentorship. We will thread a strong gender and inclusivity theme across these four components. We will continue to work with the AAS through training programs, policy formulation, brokering new partnerships (e.g. AAS with the Royal Society of Edinburgh) and participation in AAS dissemination activities. TIBA fellows will be encouraged and supported to apply to 'Future Africa' and similar programmes designed to develop scientific leadership skills. Providing equipment and research resources for the trainees to utilise in the home institute will ensure sustainable technology transfer, so that knowledge could be cascaded within the home institute.

We will seek to deliver short training courses requested by our Africa partners covering technical skills (e.g. molecular diagnostics), data science, research governance and professional skills. All short-courses will be delivered in Africa, in-person whenever possible.

In response to training needs highlighted during the co-creation of our sustainability plan with stakeholders and partners, TIBA will have a new partnership programme of industry internships to be offered by our seven industry partners: AVMI, AVIA-GIS, Merck, Leaf Pharma, Praedicare, GSK and PEPperPrint. Each will involve work in one of our core themes – diagnostics, therapeutics and vaccines – in the context of NTDs in Africa. These will provide opportunities for young African scientists to gain experience of working in a commercial research environment and develop links with industry researchers.

We will continue to translate our research into improved policy and practice by working closely with national Ministries of Health and health agencies and with our key international stakeholders: WHO AFRO, the AAS and AUDA-NEPAD. Our existing contacts and close working relationships with all these bodies mean that policy-relevant findings from TIBA's research to date can continue to be

translated into health benefits to African populations.

Our overarching criteria for project success are set out in our Theory of Change Framework (previously submitted). Success criteria include: i) training provided in CEI, plus evidence of improved practice; ii) evidence of engagement with national stakeholders; iii) evidence of engagement with key international stakeholders – WHO, WHO AFRO, AUDA-NEPAD, AAS, ARUA; iv) auditable epidemic response capacity built at University of Nairobi; v) commissioning, approval and delivery of at least three research projects responding to real-time infectious disease challenges.

TIBA must now work in a climate of low trust in UK partners resulting from the recent ODA cuts. The NIHR's decision not to fund the TIBA renewal application has caused further disquiet at the highest levels of global health in Africa where there has always been the strongest possible support for TIBA (see Letters of Support for TIBA's Sustainability Plan).

Other Progress

TIBA is now an internationally recognised brand for health research and implementation in the global health arena, with an excellent working relationship with major stakeholders such as WHO, WHO AFRO, AUDA NEPAD and Gates Grand Challenge.

TIBA has built a reputation for delivery and relevance and our philosophy of enabling and bringing together leading African scientists to solve Africa's health challenges resonates with major players on the continent, such as the African Academy of Science. TIBA's inclusive approach fostering relationships between African institutions and scientists has ensured that strong relationships and networks have been forged within the partner institutes which should contribute to sustainability of research expertise and of health impacts gained through the partnership, regardless of the future direction of TIBA. In addition, TIBA has ensured that expertise in Africa that is of global relevance has been transferred via workshops directed at UK and other NIHR groups.

With TIBA support, University of Edinburgh researchers established new networks with colleagues in Africa resulting in new collaboration and funding application. For example, the Wellcome Centre for Cell Biology at the University of Edinburgh established research collaboration with WACCBIP at the University of Ghana. They have since secured a Royal Society International Collaborative Award to explore epigenetic regulation of artemisinin resistance in *falciparum* malaria.

One of the recommendations made by our African partners is that in the future the NIHR should provide advance notice of reporting requirements and remain consistent throughout the programme's lifetime. For example, the financial audit at the end of a 5-year programme may present potential challenge of loss of institutional memory owing to individuals and staff moving on from any one institution. We suggest that if such activity is to be a requirement, then it should be undertaken annually. We continue to stress that the administrative requirement by the NIHR associated with the global health programme is beyond precedent and significantly cuts the time available for researchers to dedicate to their primary work. A particularly ill-timed development was the announcement that the NIHR would conduct a full financial in the midst of the COVID-19 pandemic, a period when many of our partners were heavily involved in national pandemic responses and had more than enough pressures of their time.

TIBA has been able to flourish and have tremendous impact because the partners have been allowed to draw on their innovative and rigorous approaches to all aspects of the project – research, research governance, pathways to impact – drawing on their cumulative decades of experience of delivering high quality research relevant to health policy or practice. TIBA's policy of absorbing as much of the administrative burden as possible centrally has helped our partners to achieve TIBA's objectives.

Less easily addressed is the frequently heard criticism that NIHR's GHR programme is both prescriptive and patronising. This view emerged from the first Directors' meeting where LMIC partners were almost invisible and it was made clear that the NIHR's objective was to export to LMICs a UK-centric view of what science was needed and of how that science should be done.

The main reason for TIBA's many successes in delivering research and impact was that it took a very different approach. However, although the TIBA model has been publicly praised by the WHO Director, WHO AFRO Regional Director, AAS President, the AU and others, our application for renewed NIHR funding was not successful. That decision is widely viewed as sending the message that TIBA's model of undertaking genuinely Africa-led research, moving the centre of gravity to Africa, truly equitable partnership and inclusivity is not one that the UK wishes to support, even though by every available metric TIBA was among the best performing of the NIHR GHR Units. As one of the most senior scientists on the continent put it: 'the NIHR has just scored the most spectacular own goal in the history of R&D funding for global health in Africa'. Another simply said they were 'horrified'. [Permission given for use of quotes]. It is impossible to escape the implication that African voices are simply not being heard by UK global health funders who continue to pursue their own agendas. This issue is difficult to address given NIHR's unusual policy of refusing to discuss unsuccessful applications with the applicants, even for programme renewals. We recommend this policy is revisited.

One reason why TIBA may appear a little different from (and, it turns out, be less fundable than) other programmes is that our work is genuinely Africa-led. TIBA is built on demand-driven identification of research questions by local researchers embedded in local policy and health practitioner networks. This is fully consistent with our aim of addressing locally identified challenges in LMICs through equitable research partnerships. It guarantees that there is a "market" for the research outputs and greatly increases the likelihood of uptake and having impact. Our African colleagues place great emphasis on operational, delivery and implementation research. Key components therefore include field data collection, multi-disciplinary approaches, social and cultural contexts of the research, and translation and capacity building for sustainability. TIBA respects these priorities and they will continue to be reflected in our future research strategy. We have no wish to impose a UK-centric view of how to do science in Africa.

Environmental Impact

We adopted the University of Edinburgh 'Sustainable Travel policy' which sets out the procedures for booking work related travel and accommodation when travelling locally, nationally or internationally on behalf of the University and applies to all staff, students and visitors. Our partners in Africa also followed relevant travel policies of their local institutions.

By adopting this policy, TIBA has been able to better manage the carbon emissions and associated environmental impacts from travel by encouraging colleagues to travel less and use lower-carbon methods of travel where feasible.

The policy also supports staff wellbeing by encouraging them to only undertake necessary travel and promotes inclusion via an "exceptions" mechanism to ensure that no-one with caring responsibilities, disabilities, or other exceptional circumstances is negatively affected by the policy.

Policy headlines include:

- reducing the overall number of journeys in favour of virtual collaboration tools especially during the COVID-19 pandemic;
- if travel is necessary, favouring low carbon transport options;
- a presumption against air travel within mainland Great Britain;
- the default class for air travel is economy, with premium tickets reserved for disability or for other health-related reasons.

Where possible, multiple TIBA meetings or engagements were organised at one venue. For example, our second annual general meeting and funder's forum were both held in Ghana at the same time. Similarly, colleagues travelling for meetings used the opportunity for field visits and community engagement as was the case of the GFGP workshop in Rwanda in which the TIBA team visited

research field sites at Nyamasheke with colleagues from the NIHR.