2ND TIBA ANNUAL GENERAL MEETING

16 – 18 September 2019 | *Fiesta Royale Hotel, Accra, Ghana*

Meeting Report



UNIVERSITY OF GHANA | WACBIP | tiba | NIHR | National Institute for Health Research



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Background

The 2nd Tackling Infections to Benefit Africa (TIBA) Annual General Meeting (AGM) was hosted by TIBA Ghana from September 16 to 18 2019 at the Fiesta Royale Hotel in Accra, Ghana. In attendance were members of the TIBA Directorate, staff of the Directorate and TIBA Ghana, country Principal Investigators (PIs), students, and representatives of funding & stakeholder organisations, who took part in the Funders & Stakeholders Forum. Stakeholders included the Principal of the University of Edinburgh, representatives from Africa Centre for Disease Control & Prevention, Africa Research Network for NTDs, Deutscher Akademischer Austauschdienst (DAAD), the African Academy of Sciences (AAS), Merck, the New Partnership for Africa's Development (NEPAD), the United Kingdom Department of Health and Social Care, and the Wellcome Trust.

Objectives

The purpose of the meeting was to get:

- Feedback on Rapid Impact Projects by Principal Investigators (PIs)
- Feedback on progress of TIBA by the External Advisory Group (EAG)
- Feedback on Making a Difference Projects
- Reports on the work of TIBA Out of Africa fellows
- Feedback on TIBA activities in capacity building, dissemination & emergency preparedness.
- Feedback on Post-Graduate Fellows' Progress

Venue

The meeting was held at the Fiesta Royale Hotel in Dzorwolo, an upscale suburb of Accra, close to the University of Ghana, where TIBA Ghana is hosted. Its exact location is 13 Afari Djan Street, ECOMOG Avenue, George W. Bush Highway. The main meeting proceedings were held in the **CEDAR** Hall, located on the main courtyard of the Hotel; the Post Graduate Fellows' poster session was held in the **AFZELIA** Halls near the hotel lobby; and the EAG Meeting was held in the **EMERI** Hall of the hotel.





MEETING PROCEEDINGS

DAY 1

WELCOME REMARKS



Professor Gordon Awandare, Principal Investigator of the TIBA Ghana project, welcomed delegates and highlighted the importance of the TIBA project to research on the African continent. He spoke about the impact TIBA has made on the research mission of the West African Centre for Cell Biology of Infectious Pathogens (WACCBIP), supporting the Centre's broad range of research activities and training programmes. He said that WACCBIP, which runs the TIBA Ghana project, was very proud to be the only partner of TIBA in West Africa.



Professor P. F. Ayeh Kumi, Provost of the College of Health Sciences at the University of Ghana, who gave the welcome remarks on behalf of the Vice Chancellor of the university, spoke about the TIBA Partnership's importance as one of the various projects contributing to attaining the University's goal to become a research-intensive institution. He explained that the focus areas of the TIBA project made it an essential element in efforts to solve national healthcare challenges, and encouraged delegates to persist in their efforts to find solutions to the healthcare challenges facing Africa.

UPDATES FROM TIBA DIRECTOR



After welcoming delegates & stakeholders to the meeting, *Professor Mark Woolhouse*, Director of TIBA, presented an update on the status of the programme. Placing TIBA's overarching aim into context, he explained how the Partnership seeks to explore and draw lessons from the different ways African health systems tackle neglected tropical diseases, with the intention of improving healthcare across the continent. He said that TIBA's pioneering work seeks to study different parts of the health ecosystem in Africa, with the aim of drawing lessons that will inform health policy and the continent's health R&D environment, while also providing health solutions for vulnerable populations. Prof. Woolhouse explained that the Partnership seeks to achieve its aim by ensuring that its research is Africa-led, with a centre of gravity firmly grounded in Africa, while striving for inclusive engagement within truly equitable partnerships. He said that the programme had made a lot of important progress towards achieving this over the three years of its existence. He mentioned TIBA's work with WHO-AFRO and EDCTP on developing the National Health Research Systems 'barometer', a toolkit that will help identify strengths and gaps in health research capacity in Africa. He said that TIBA is working to develop a strategy and roadmap to help WHO-AFRO member countries address any weaknesses identified by the barometer. He also spoke about TIBA's on-going work with the African Vaccine Manufacturers Initiative on a roadmap towards an Africa-wide policy on vaccines. He explained that the policy would provide a way to enhance Africa's capacity to tackle vaccine-preventable diseases. Prof. Woolhouse also revealed that TIBA was helping Merck KGaA in their efforts to deliver a new drug formulation for paediatric schistosomiasis, and WHO on developing new guidelines for mass drug administration that will allow 50 million children under five years old to be treated for paediatric schistosomiasis across Africa. He presented details of progress made on each of the Work Packages under the TIBA project. He encouraged everyone involved with TIBA to contribute to achieving the Partnership's overarching aim by applying the best of their abilities to their individual projects and by sharing the outcomes of their research as a way of facilitating peer-learning. According to Prof. Woolhouse, if those two things can be achieved, the Partnership will achieve far more than any individual could by working alone.

OFFICIAL OPENING



Professor Felix Dapare Dakora, President of the African Academy of Sciences, officially opened the meeting. He praised the TIBA initiative and all its contributors for the work they do across the continent. He commended the Partnership for championing Africa-led research through collaboration. He said that the continent is a large one and that African scientists need to find commonalities and work together to solve its many health challenges. He entreated funders to continue supporting TIBA, as well as other initiatives like it across the continent. He declared the meeting officially open and encouraged delegates to participate fully and have fun doing so.

GUEST LECTURE



Professor Ernest Aryeetey, Secretary-General of the African Research Universities Alliance (ARUA) and former Vice-Chancellor of the University of Ghana, spoke about the importance of research partnerships among African institutions. He said that African universities have the capacity to conduct transformational research, if institutions prioritise

collaboration beyond national and regional borders. He explained that collaborative research among African institutions is now more feasible due to advancements in ICTs and the ease of access to these technologies. He discussed ARUA's role in fostering partnerships among institutions across the continent, detailing the opportunities the Alliance creates for African scientists at all levels.

KEYNOTE ADDRESS



In his keynote address titled 'Malaria Eradication Feasible in a Generation', *Professor Fred Binka*, Professor of Clinical Epidemiology at the University of Health & Allied Sciences, discussed the possibility of malaria eradication, the challenges hindering eradication, and the steps required to reach that goal within a generation. He explained that although the necessary tools are already available, efforts towards incorporating new tools need to be accelerated to reach the goal of eradication faster. He said that stakeholders need to innovate within their healthcare systems to increase access to healthcare, license all health workers to treat malaria and create interventions such as Mass Drug Administration, ITTNS, Indoor Residual Spraying, and elimination of foci of transmission. He called for high political commitment and an increase in domestic funding, while stressing the need for the adoption of a credible multi-sectoral approach to eradicating malaria. Presenting a historical breakdown of various major malaria interventions, Prof. Binka pointed out the progress made in the development of solutions to the malaria problem, while teasing out key lessons from the shortcomings of these interventions. He explained that although Ghana is among the top 10 high-impact malaria-burdened countries, malaria eradication is possible if efforts in countries such as Zambia, whose government has fashioned a National Malaria Elimination Strategic Plan to beat malaria by 2021, are mirrored by the Ghanaian government. He suggested strategies the country could use that would ensure malaria eradication, including the establishment of an operational national elimination taskforce or committee that would be multi-sectoral, requiring efforts from local government, central government, the Immigration Service, schools, etc. He said it was important to also make sure there was mandatory malaria case notification, case-based malaria surveillance, drug resistance monitoring, entomological surveillance and outbreak detection and response. He said that the biggest challenge is to reduce transmission in Africa and called for more effort towards the reduction in transmission and disease burden, stressing that current interventions are inadequate.



PROGRESS REPORTS

WORK PACKAGE 1

PROGRESS REPORTS



tibaKenya

Headed by three PIs; Prof. Faith Osier (Malaria Vaccinology), Prof. George Warimwe (Virus Epidemiology & Vaccines) & Dr. Sam Kinyanjui (Malaria Immunology), the Kenyan team mainly focuses on the development of viable vaccine candidates, according to *Dr. James Tuju*, who presented the progress report. He explained that, based on evidence that some humans become immune to malaria, the team is working to understand what targets antibodies in immune persons attack on the parasite, and which point in the blood stage of the infection the antibodies are administered. He said that although there have been challenges in validating vaccine candidates, the team is

- working with SMART (South-South Malaria Antigen Research Partnership), a partnership led by Professor Faith Osier, which gives them a standardized way to study the antigens; and
- setting up controlled human malaria infections to distinguish immunity from lack of exposure, as well as using high throughput methods to study many antigens at a time.

The team's work is based on work completed under the *Rapid Impact Project* by Gathoni Kamuyu, a TIBA postdoc fellow, who characterised the surface of merozoite, using mass spectrometry and reverse vaccinology approaches.

Their *Making a Difference Project* focuses on characterizing antibodies isolated from humans. After screening immune adults for antibodies and finding antibody reactivity to the antigens, they tested the ability of the antibodies to recruit complement and to elicit neutrophil function. There was no *in vitro* activity and there was unspecific recognition of antibodies induced by immunisation with CD4.

Next steps include developing methods to analyse the high throughput microarray data coming from the SMART analysis, using monoclonal antibodies to identify malaria antigens that are targets for immunity, characterising these antibodies using immunoprecipitation & running them on the microarray chip, assessing the impact of declining transmission on measures of naturally acquired immunity against *P. falciparum* malaria over a period of 25 years, and identifying protective antibodies against *P. falciparum* variant surface antigens.



tibaRwanda

Dr. Aline Uwimana presented the Rwanda report. She provided updates on the team's *Rapid Impact Project*, which focuses on evaluating the impact of e-health in the management of severe malaria cases in Rwanda. Their 10-person team, in collaboration with stakeholders in other countries, came up with a malaria contingency plan, that seeks to strengthen the early management of malaria care to reduce death rates. The plan also allows community health workers to send messages using telephones to alert district pharmacies when they need more drugs and when they need to transfer severe cases.

She also talked about their *Out of Africa Fellows'* work evaluating mixed malaria infections and developing a response surveillance system in Rwanda, with the aim of evaluating the existence of non-*falciparum* species, to assess a diagnostic test suitable to accurately detect different *Plasmodium* species, and to analyse transcriptome of whole blood samples infected with mixed parasite species. They are still in the field work process.

For their *Making a Difference Project*, the team is working to understand schistosomiasis among children under the age of five. The project seeks to determine the prevalence of the disease and its associated morbidity, map its distribution, identify cost-effective channels for assessing the children for mass drug administration or case management, map the distribution of the snail intermediate hosts, and identify immunological markers associated with infection and morbidity. Field work was completed in September 2019. The next stage is to complete the snail survey, treat positive cases, analyse data and prepare a stakeholders meeting to share results.

Dr. Uwimana also discussed tibaRwanda's mini-*Rapid Impact Project* focused on measles epidemiology, particularly of measles virus genotypes associated with outbreaks in Rwanda in 2019-2020. The team has collected data samples from suspected cases, written and validated a Standard Operating Procedure (SOP) on measles & measles RNA extraction.

There is also a PhD project that is quantifying and mapping out water contaminants and their association with infectious diseases in Rwanda, and a malaria resurgence project aimed at characterising immune profiles of populations exposed to *Plasmodium* parasites with differing clinical manifestations, determining the strains of parasites carried by the study population and assessing their sensitivity to anti-malarial drugs, and relating anti-malarial behavior with immune profiles and parasite strains.



tibaSudan

The progress report was presented by *Professor Maowia Mohamed Mukhtar*, who, after assuring that the political climate had improved, spoke about Sudan's five TIBA projects. Their *Rapid Impact Project* is laying the foundation for plans towards malaria elimination. Their objectives include improving the malaria surveillance system, improving malaria diagnosis using Rapid Diagnostic Test (RDT), establishing a malaria molecular diagnostic and drug monitoring system, and auditing malaria data from 2016-2018 and mapping the geo-distribution of *Plasmodium* species. So far, they have audited the historical data of malaria reports from 2016 to 2018 and have developed a GIS map of the 193 malarial diagnostic centres in Khartoum. They have also determined the prevalence and incidence of four *Plasmodium* species, improved malaria diagnostics by examining several cases with RDTs, and trained 42 malaria laboratory technicians and 21 public health officers on malaria diagnosis, sample collection, processing and results recording. He mentioned that the WHO has benefited from their HRP2 mutation study for evaluating the sensitivity of malaria RDTs.

The *Out of Africa Project* focuses on the genetically homogenous parasite, *Leishmania donovan*, that causes four different clinical diseases. He discussed the work tibaSudan is doing to figure out if there are any genomic markers associated with those diseases..

Their *Making a Difference Project* is dedicated to the development and evaluation of a comprehensive multiple peptide array serological diagnostic for use in Africa. He said the project is important because most African countries, like Sudan, have a problem with the accurate diagnosis of fever. Most fevers are misdiagnosed as malaria and typhoid fever. He said the project will be helpful in accurate diagnosis of re-emerging diseases, such as the epidemic of *Chikungunya* in Sudan.

Another *Making a Difference Project* explores the contribution of maternal transmission and silent carriers in the epidemiology and persistence of African trypanosomiasis in human and animal populations. Professor Mukhtar said that they are working with their colleagues in South Sudan to monitor some cattle migrating there, possibly carrying *Trypanosoma brucei*, which the project will help accurately identify and characterise. He added that the project will also study trypanosomiasis in camels in Eastern Sudan, since the camels migrate through large areas which may expose them to the disease.



tibaGhana

Professor Gordon Awandare presented updates on the four projects tibaGhana is involved with. For their *Rapid Impact Project*, the team looked at the effects of artemisinin-based combination therapy (ACT) on the dynamics of *P. falciparum, P. malariae* and *P. ovale* infections in Ghana. He revealed that a significant level of *falciparum* infections was found in healthy people (as much as 30-40 percent in some areas), in addition to non-*falciparum* species (under 10 percent). Some healthy cases had only the non-*falciparum* species, and a small percentage of people had all three occurring together. Those who were co-infected with *P. malariae* were 10-30 percent and those with *P. ovale* were 5-15 percent. He mentioned that the project has received a lot of interest from other collaborators and funders, which has kept it going.

Under the *Making a Difference Project* the team explored novel candidates for anti-malaria vaccines identified using functional monoclonal antibodies in naturally exposed individuals. So far, they have characterised 20 proteins and expressed 15 of them. Their next step is to do a functional characterisation using conditional knockouts, and also immunisations to generate antibodies. A **second** *Making a Difference Project*, in collaboration with tibaZimbabwe & tibaSudan, is focused on developing and evaluating a comprehensive multiplex peptide array serological diagnostic for use in Africa, which will help reduce misdiagnosis of malaria and help in identifying non-malaria fever illnesses.

He mentioned that progress was being made on their *Out of Africa Project*, focused on the identification of *P. falciparum* var gene sequences in IgM-binding rosetting clinical isolates.

He also spoke about the work tibaGhana is doing in community & policy engagement, securing working relationships with research centres, district directors of health, and staff of hospitals and clinical labs. He spoke about training of hospital laboratory personnel on identification of different parasite species and the provision of free health screenings to residents in several rural communities, as well as community durbars to educate people about malaria and other common infectious diseases. He mentioned some papers being worked on under the project, including a paper on detection of *P. ovale* and *P. malariae* using cognitive primers, as well as one on analysis of *Plasmodium falciparum* Rh2b deletion polymorphism across different transmission areas, which is under revision at *Scientific Reports*.



tibaZimbabwe

Professor Simbarashe Rusakaniko gave details of the six projects under tibaZimbabwe. Their *Rapid Impact Project*, led by Professor Elopy Sibanda, sought to adapt international criteria for the diagnosis of autoimmunity and allergies for specificity to African populations. The project is addressing the international criteria for diagnosis of systematic sclerosis and associations with allergy in the Zimbabwean populations.

They have awarded three candidates the *Out of Africa* fellowship; two have completed their scheduled visits to the University of Edinburgh, with the last one yet to visit. For their **first** *Making a Difference Project*, they are seeking to understand schistosomiasis among children under five years old. They have gained ethical approval and recruited research assistants for the project, and screened some children aged 2-5. The **second** *Making a Difference Project*, lead by Professor Takafira Mduluza, is evaluating a comprehensive multiplex peptide array for serological diagnostic and surveillance of infectious diseases endemic and epidemic-prone in Zimbabwe.

He said that tibaZimbabwe has planned community engagement programmes on schistosomiasis control, identification of transmission mode among pre-school-aged children (PSAC), laboratories, the layman, and clinical diagnosis and access to treatment. They have also undertaken a project in collaboration with Merck, called the PZQ efficacy trial, which seeks to assess the efficacy of paediatric praziquantel in Zimbabwe. Funding for the trial has been secured and they have completed site visits and sensitised the Mutoko District hospital team.

He announced that the team has also completed a pilot case study on characterising wellness interventions in targeted public and private organizations in Zimbabwe. He explained that the study was important for healthcare provision, as the workplace is often neglected when thinking of healthcare, although it provides a convenient place for the spread and containment of infections.



tibaBotswana

Professor Nthabi Phaladze presented a report on their project focused on the analysis of schistosomiasis in the Okavango Delta in Botswana. Their main objective was to determine the extent and magnitude of schistosomiasis in Ngamiland, with a view to influence policy and resource mobilization. The study was done in primary schools in the areas of Shakawe, Kathiana, Kauxwi, Etsha, and Maun. Schools were selected based on proximity to the river. Their findings revealed that 85 percent of respondents perceived schistosomiasis to be a health threat, with only 4 percent believing it was contagious, and 90 percent believing that an increase in the number of cases for bilharzia might have consequences for the village inhabitants. Results revealed that Shakawe and Kauxwi primary schools each had 34 cases of *S. haematobium*. Cases of *S. mansoni* were few and cases of helminths were highest in Shakawe schools. Results from Maun schools reported few cases of *S. haematobium* and *S. mansoni* and higher cases of other helminths. Children who tested positive received treatment, a total of 179 girls and 134 boys. Praziquantel was provided and administered by the Ministry of Health and the Wellness Neglected Tropical Diseases Unit per WHO guidelines. The tibaBotswana team successfully completed all fieldwork projects within the time frame. In addition, one PhD student and one MPhil student are working on projects and are awaiting IRB comment. The team also trained 20 research assistants, held four community mobilisation and sensitisation workshops, disseminated findings in Maun, and held a successful stakeholder meeting in Gaborone, with the TIBA Co-Deputy Director, Moses Chimbari, in attendance. Three of their postgraduate fellows attended a three-credit research method course at the Okavanga Research Institute from January-February 2019; three of their field technicians at the Okavanga Research Institute participated in the snail scooping exercise as part of the project; and one postgraduate fellow attended an Evidence Synthesis workshop in Ghana in May 2019.

Dr. Maitshwarelo Matsheka, who is also part of the tibaBotswana team, gave a short presentation on work at the Botswana Institute for Technology Research and Innovation (BITRI). They have some approved TIBA projects , including an *Out of Africa* project on the development and evaluation of a colorimetric isothermal amplification based assay for the detection of urogenital and intestinal schistosomiasis, and a *Mini-Rapid Impact Project* on the use of the MinION real-time genomic sequencer for the epidemiological investigation of Rotavirus outbreaks post vaccine introduction.



MEETING PROCEEDINGS

DAY 2

PROGRESS REPORTS



tibaUganda

Professor Charles Waiswa spoke on the tibaUganda project focused on understanding factors critical to the elimination of sleeping sickness in Uganda. He discussed the 10-year persistence of trypanosomiasis in Uganda, despite efforts to eradicate it. According to him, they are using the *Rapid Impact Project* to pursue how to eliminate the problem.

The area they surveyed for the project, the Lango sub-region, had livestock suspected to be likely carriers of trypanosomiasis. They also took samples of people living there. Their findings showed that their interventions were able to reduce *T. brucei sl.* in the animals. The situation was presented and discussed by TIBA project stakeholders in Kampala in March 2019. He highlighted how the findings can help Uganda in policy planning, diagnosis and case detection, treatment and post-treatment care, and reduction of tsetse-man-tsetse-animal contacts.

Professor Waiswa also mentioned a study by PhD fellow, Robert Mandela Wangoola, whose work is focused on trypanosomiasis prevalence, stability, and factors leading to continued cattle infection in the Lango sub-region. He has collected field samples and has a collaborative publication on the project in the pipeline.

The tibaUganda team also held a stakeholder engagement forum with 120 participants and presented their TIBA multi-stakeholder approach at the WAAD conference in Florida. Their *Out of Africa* fellow, Dr. Albert Mugyeni, has travelled to Edinburgh, and has been devoted to data collection and database buildup. He has drafted a manuscript for publication, and it is being scrutinised by the different stakeholders.



tibaSouthAfrica

Professor Moses Chimbari, who is also TIBA Co-Deputy Director, detailed the use of the 7 million pounds, spanning nine Rapid Impact Projects- £100k; five Making a Difference Projects - £500k; four Toolkit Projects - £100k; nine NIHR-funded In-Africa PhD studentships - £75k; nine NIHR-funded Out-of-Africa research fellowships at the University of Edinburgh (yet to be determined); three In-Africa fellowships funded by African partners; In-Africa training programmes - £125k; & £40k for meetings and ICT.

He discussed tibaSouthAfrica's *Rapid Impact Project* on preparing for an effective mass drug administration programme for South Africa. The aims, which have all been accomplished, were to determine the prevalence, intensity, risk factors, knowledge, practices and attitudes towards schistosomiasis and Soil-Transmitted Helminths infections among pre-school-aged children (PSAC), as well as see its effects on cognitive and physical function and how it can be assessed during treatment programmes.

Their *Out of Africa* fellow, Dr. Muhubiri Kabuyaya is currently working with Professor Liz Grant at the Global Health Academy, University of Edinburgh. His work is to review national mass drug administration progammes of schistosomiasis in Sub-Saharan Africa, spending time in Tanzania, Zanzibar, Uganda and Zimbabwe.

Their capacity development activities have included some supervision, proposal development, manuscript writing, thesis writing, and team-building and leadership workshops, as well as community research assistants training and a workshop for enhancing skills in biostatistics, parasitology, malacology and social science methodology.

He spoke about the help they have had from: NRF for their community engagement project, British Academy funding for the WASH Project and PSAC projects, and the proposal they have submitted to the Wellcome Trust on a public engagement programme named 'Social Practice Creative Placemaking' that they hope will help dispel information in a more easily understood way.



tibaTanzania

Dr. Paul Erasto Kazyobai, who spoke on behalf of Dr. Upendo Mwingira, discussed tibaTanzania's work on schistosomiasis in infants and pre-school children based on Point-of-Care circulating antigen tests in North-Western Tanzania. He said one of their researchers, Dr. Humphrey Mazigo, is working on assessing the impact of selective and timed treatment strategies on *Schistosoma haematobium* prevalence, intensity and urogenital morbidities in North-Western Tanzania.

Their PhD fellow, Dr. Andreas Nshalla, is working on accelerating lymphatic filariasis (LF) elimination in persistent hotspots zones/communities in Tanzania. He detailed work done on the *Rapid Impact Project*, which focuses on monitoring of lymphatic filariasis in persistent hotspot transmission zones. Strategies include intensifying Ivermectin + Albendazole MDA for LF, proper monitoring of Mass Drug Administration (MDA) and infection levels and capacity building of grass-root MDA implementers and supervisors. They selected two districts and completed 11 rounds of MDA, passing their target epidemiological coverage of 65 percent and above. Some of the challenges they encountered included the aggregation of treatment data by CDDs and the interference of the rainy season during MDA. The team also trained community drug distributers, frontline health workers and supervisors from the communities.

For their *Making a Difference Project* the team is looking to understand schistosomiasis among children under five years in Tanzania. It is focused on determining the prevalence, intensity, hepatosplenic and urogenital morbidities and capacity of primary health care to diagnose and treat schistosomiasis. The sites they surveyed were the Geita DC-Nkome peninsula, Ukerewe DC and Uyui DC. After screening 1493 children, 29.3 percent were found to be positive through urine CCA test. Their ongoing activities include screenings, assessments of treatments and healthcare facilities, laboratory work examination of Kato Katz thick slides, data entry, cleaning and analysis, and preparing manuscripts for publication.

OUT OF AFRICA FELLOWS' REPORTS

An update was given by each of the *Out of Africa* Fellows.



Ramatlha Tsepo from tibaBotswana spoke about the evaluation of DNA-based PCR essays for detecting urogenital and intestinal schistosomiasis in Botswana. The infection, which is usually found among preschool children in Botswana, is a neglected tropical disease.

Henrietta Mensah-Brown, a fellow from tibaGhana, presented her study on identification of *Plasmodium falciparum* var gene sequences in IgM-binding resetting clinical isolates. The study is aimed at reducing the frequency of certain PfEMP1 parasites to reduce malaria severity.

Simon Masha, a fellow from tibaKenya, talked about his project on a health systems approach towards inclusion of chlamydia and trichomoniasis screening for women attending anti-natal health clinics. In a study he did in 2017, one in five women they surveyed at an anti-natal health clinic were infected with one of the STI's, and these infections caused adverse pregnancy outcomes.

Jean-Pierre Munyampundu from tibaRwanda talked about his study on the evaluation of mixed malaria infections and developing a responsive surveillance in Rwanda. The project consists of two parts: the diagnostic part, concerned with evaluating the existence of non-*falciparum* species; and real time malaria surveillance, concerned with developing a model to present malaria data in a format that policy makers can understand.

Muhubiri Kabuyaya from tibaSouthAfrica presented his research on the review of national mass drug administration (MDA) programmes of schistosomiasis in Sub-Saharan Africa. He underlined that 20 years of MDA had not eliminated schistosomiasis, particularly in Sub-Saharan Africa which made a review of the underlying health systems essential.

Mohamed Abdelrahim from tibaSudan presented his study on the identification of genomic markers of different clinical phenotypes of Sudanese leishmaniasis. The disease, which is transmitted by female sandflies, is distributed in the eastern side of Sudan, to the southern border, and some parts along the Nile.

Humphrey Mazigo from tibaTanzania talked about his research work on assessing the impact of selective and timed treatment strategies on *Schistosoma haematobium* prevalence, intensity and urogenital morbidities in north-western Tanzania. Dr. Mazigo's research work aims to set up trials and interventions, based on the areas with prevalence higher than 30 percent, and assess the effects of treatments they give.

Albert Mugyeni from tibaUganda gave insight into his project that seeks to measure spatial risk for trypanosomiasis in Uganda through tracking tsetse abundance and assessing the impact of climate-driven tsetse on HAT transmission. So far, the team has had practical engagements, undertaken risk mapping, and developed a spatial information system to plan, monitor and implement programmes.

Farisai Chidzwondo from tibaZimbabwe spoke on her project on the development of an appropriate multiplex tool for diagnosing and responding to infection in Zimbabwe. The research addressed the question of whether a given sample can be used concurrently to detect antibodies to several infectious agents common in Zimbabwe. The multiplex tool should make it possible to identify current and re-infections, as well as determine antibody levels after vaccination in children.

Takafira Mduluza, also from tibaZimbabwe, gave a brief description of his research work on design and evaluation of multiplex immunological techniques for diseases surveillance, diagnosis and control in Zimbabwe. He explained that diagnostics was a challenge, and a tool that could screen the type of infections that people were exposed to would help in outbreak prevention.

Simbarashe Rusakaniko, from tibaZimbabwe as well, talked about his project on the development of a bioinformatics curriculum for the University of Zimbabwe. He spoke about the importance of a computer-based approach to biological research, saying collaborative effort and input was needed to make it successful.





MAKING A DIFFERENCE PROJECTS

WORK PACKAGE 2

MAKING A DIFFERENCE PROJECTS



Dr. Ann Kinyua spoke on the Kenya-based project on variant surface antigens as potential targets for malaria vaccines. Their overall goal is to identify/develop novel antigens that can be used as vaccine candidates against malaria. She spoke about how, during the blood stage infection, *Plasmodium falciparum* greatly remodels the infected erythrocyte by exporting the parasite antigens onto the surface of the infected red cells. She said that VSAs have been known to contribute to malaria pathogenesis, and their highly polymorphic nature allows them to bind to a wide array of receptors. Understanding how VSAs interact with the host receptors will help identify how to use VSA's as vaccine candidates. She said that the challenge with this was that there is a large amount of VSAs, so immunity requires acquiring a large range of antibodies.



Dr. Emmanuel Amlabu, representing the tibaGhana team, spoke about the *MaD* project, which is in collaboration with KEMRI-Wellcome Trust, that focuses on the blood stage development of the malaria parasite with a view to identify new targets for malaria vaccine development. In partnership with the Kenya team, their aim is to identify a panel of novel *P. falciparum* invasion or egress-related proteins using several protein informatics portals for functional characterisation as potential blood-stage malaria vaccine target.



Professor Charles Waiswa spoke about tibaUganda's partners, Nigeria and Sudan. Their project is focused on eliminating sleeping sickness and their aims include understanding the role of silent carriers and maternal transmission in maintaining gHAT and rHAT in endemic foci, using modern tools to generate knowledge to eliminate the sickness, determining the contribution of maternal transmission in cattle to AAT and the zoonotic rHAT burden, and exploring sociocultural economic and psychosocial dimensions to gHAT diagnosis, treatment, burden and recovery from the perspective of ex-patients. Professor Waiswa spoke about their future plans, including a deeper understanding and strengthening of the rapid and mobile diagnostics tools, and the domestication of the knowledge and tools by the Ugandan government, by establishing a resource centre to focus attention on trypanosomiasis surveillance.



Professor Moses Chimbari spoke on South Africa's *MaD* project that seeks to understand schistosomiasis among children under five years (USaCuF). Their key objectives are to determine the magnitude of schistosomiasis among pre-school-aged children (PSAC) and to develop a strategy for accessing under-five-year-old children for treatment of the disease. He also spoke about their additional value adding objectives which include:

- to determine the risk factors for schistosomiasis among PSAC (All countries)

- to compare the burden of schistosomiasis and soil transmitted helminths (STH) between school age children (SAC) and pre-school-aged children (PSAC) (South Africa)
- to map the distribution and infectivity of snail intermediate hosts for schistosoma parasites in endemic areas (All countries); and
- to identify immunological markers associated with infection and morbidity (Rwanda and Zimbabwe)

In Zimbabwe, they are working in two districts: Murehwa and Shamva districts. In Tanzania, they are working on three districts: Geita DC, Ukerewe DC and Uyui DC. South Africa is working on the Kwazulu-Natal Province.

He spoke about some of the milestones. Rwanda has gained ethics approval, hired a research assistant, held a meeting with the technical team from University of Rwanda and Rwanda Biomedial Centre, conducted pre-survey visits and sensitization, and completed field work on September 3, 2019. Zimbabwe has received ethics approval, introduced their project to districts and local health centres, trained environmental health technicians and parasitologists for mapping district distribution of schistosomiasis. Tanzania also has ethics approval, has completed project publicisation to stakeholders during its 2019 Annual Stakeholders Meeting, sensitised communities before the baseline survey and completed baseline survey at three project sites. South Africa has received provisional ethics approval, held stakeholder engagement for introducing project in five of the 11 study districts and identified an effective strategy for assingessing PSAC.



Professor Francisca Mutapi spoke on the multiplex-multifunctional diagnostic tool the team is working on, in collaboration with the University of Edinburgh, tibaSudan, tibaGhana, and tibaZimbabwe. She mentioned that it is a research tool at the moment, but tibaGhana is focusing on the diagnosis during febrile illness; tibaSudan is focused on early diagnosis of emerging and re-emerging pathogens and vaccine history in refugee populations; and tibaZimbabwe is using it for surveillance of notifiable diseases and epidemic tracing and monitoring. She spoke about the development of a Pan-African diagnostic tool for pathogens, vaccine history, allergens, autoantigens and cancer

biomarkers. She explained that the tool is important because it will have Africa-specific allergens, and that the advantage of making it a serological tool was that it will be quicker, and only a single drop of blood would need to be used. She underlined the importance of the tool being multiplex, i.e. to ensure the use of many different antigens. Each chip could contain about four or five replicates of the peptides from a single sample. The work is in collaboration with PEPperPRINT, which has been a TIBA stakeholder from the beginning. The chip is also able to differentiate between recent exposure, current exposure and historical exposure.



Dr. Gloria Amegatcher, from the tibaGhana team, spoke on the Standard Operating Procedure (SOP) they developed in collaboration with tibaEdinburgh that is being used by all the three countries for peptide selection. She talked about how most fever cases among young children in Ghana are treated as malaria cases, making it hard to characterise the main causes of fever. She spoke about how the TAC molecular diagnostic assay was able to detect dengue virus, for the first time in Ghana.

Progress from the Zimbabwe group includes partnership with the National Microbiology Reference Laboratory and the district medical officers of districts with NTDs sentinel sites, identification and selection of sentinel sites and pathogens of interest and identification of reference samples held by the National Microbiology Reference Laboratory. Progress with the Sudan team includes meetings with stakeholders at the clinics and Ministry of Health, collection of literature about endemic diseases and outbreaks that occur in Sudan and archived samples for the pathogen identification and selection of sites for validation of the microarray and collection of new samples. She thanked their sponsor, the NIHR; and partners, tibaEdinburgh, tibaGhana, tibaZimbabwe and tibaSudan.



TOOLKIT PROJECTS

WORK PACKAGE 3

TOOLKIT PROJECTS



Dr. Geoff Banda explained the importance of the work package using a football analogy, comparing researchers to midfielders, and policy makers to strikers, and how they all must link up to score their goals. Their aim is to get innovations from the bench to the hospital bedside. He spoke about some of the projects they were working on, including work done with WHO/AFRO, in collaboration with EDCTP, on a National Health Systems Barometer & the AVMI-TIBA Vaccine Policy Roadmap. He invited some partners from industry to speak because, according to him, they were better placed to describe what pertains in industry, the challenges they are facing, and how to interface the work being done in the lab and strengthen health systems.



Mr. Patrick Tippoo, one of the invited speakers from AVMI, spoke about how over 60 percent of vaccines supplied by UNICEF are used in Africa, though the continent produces less than one percent of the vaccines it uses. He said there were only about four companies in Africa located in Tunisia, Senegal, Egypt and South Africa, that have vaccine manufacturing capabilities. He mentioned that sustainability was the main problem when

it comes to vaccine manufacturing. Sustainability depends on procurement channels and the markets available, which are shaped by outside players such as UNICEF. He said that political choice and political will are what will bring success to the capacity-building on the continent. He also talked about AVMI's project on the development of a novel GBS vaccine with the primary aim of developing a hexavalent GBS vaccine and a secondary aim of capacity building. Mr. Tippoo spoke about how they were going to move forward independently with the project, although their funders had withdrawn their support. He spoke about the AVMI mission which is to advance the establishment of sustainable human vaccine development and manufacturing capacity in Africa. He said that this was all towards building a roadmap to an African vaccine manufacturing policy that would catalyze political will to create an environment for sustainable vaccine manufacturing.



Mr. Josef Geoola, who works with Ingentium Limited, spoke on the importance of intellectual property support to TIBA and to Africa and the intellectual property achievements within TIBA. He spoke about how TIBA being primary contributors towards the African knowledge economy means that their innovations are intellectual property, which can be leveraged and exploited for patient benefit. He talked about how 106 intellectual property assets have been created under TIBA, the majority of these being databases, and next-generation vaccine and diagnostic technologies. He mentioned a conference held in March 2019 on scaling up African intellectual property.

Dr. Banda rounded off the session with a brief summary of the next phase in Work Package 3, which is the recruitment of a post-doctoral fellow to help in analysing the nine *Rapid Impact Projects* under TIBA and the finalisation of AVMI-TIBA conference proceedings.



TECHNOLOGY TRANSFER & TRAINING

WORK PACKAGE 4

TECHNOLOGY TRANSFER & TRAINING



Professor Gordon Awandare said that TIBA has trained 22 master's and PhD fellows so far. Across all the partner institutions, there are also 13 *Out of Africa* fellows. He detailed the several short courses the Partnership has organised, including seven workshops, spanning 20 countries and benefitting 230 people. Some of the major workshops organised include:

- Advanced Health Research Ethics - Zimbabwe
- Advanced Malaria Course - Sudan
- Real-Time Virus Genome Sequencing workshop - Ghana
- Strategic Use of Innovation and Intellectual Property Towards a Knowledge-Based Economy – South Africa
- Evidence Synthesis – Ghana
- Research Data Management – Kenya
- Toward an integrated vaccine policy – South Africa

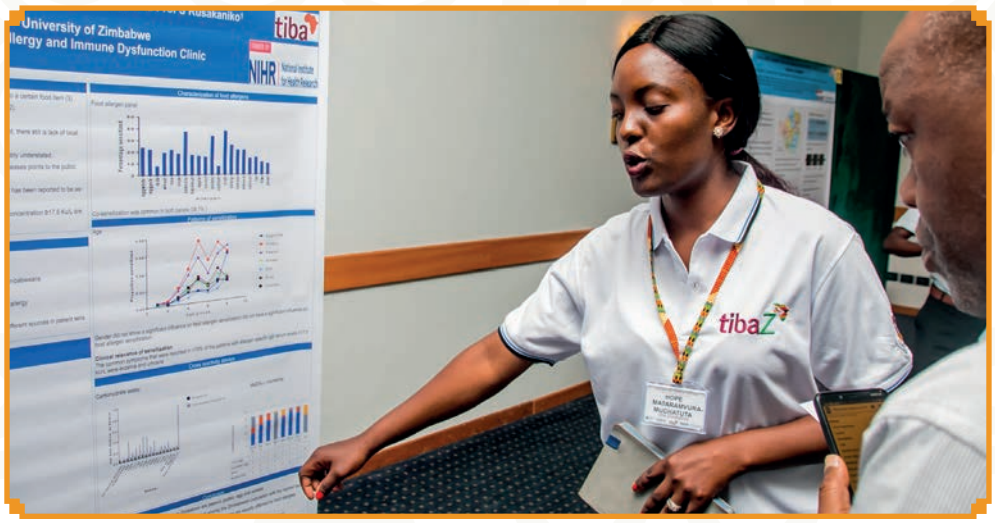
He spoke about plans to organise training in the areas of professional development, grant writing, research methods and science communication. He mentioned that TIBA is seeking partners with expertise in or planning to offer courses in the areas mentioned. He also talked about the importance of paying attention to mentorship and supervision of students and taking advantage of partners as external examiners for the students to avoid delays in thesis projects. He mentioned that acknowledging funders on theses, manuscripts and conference presentations is important, as it provides visibility for the funders & submits evidence of research output.

POSTER SESSION










Introduction:
Results:
Table 1: Number of samples
State
Number of samples
Kassala
90
Gadarif
772
Total
862









MEETING PROCEEDINGS

DAY 3



DISSEMINATION FOR ACTION

WORK PACKAGE 5

DISSEMINATION FOR ACTION



Professor Francisca Mutapi, who looks after half of the TIBA Work Package 5, detailed plans to disseminate information from affected individuals and communities, and from Ministries of Health to the development partners and stakeholders. She talked about work that tibaEdinburgh did in collaboration with tibaZimbabwe on Systematic lupus erythematosus (SLE), an autoimmune disease which is more prevalent and severe in patients of African descent. The diagnostic criteria were derived from a Caucasian patient cohort, making it unfit for diagnosing people of African descent. Her team defined the different variants of the disease and defined currently available diagnostic tools that could be used to diagnose those patients. This was well received and went viral on social media and the local newspapers. The team presented findings on assessing the national health research systems in the WHO African Region, at the WHO 68th regional meeting in 2018. The team has also been invited by WHO/AFRO and EDCTP to a consultative meeting on making a roadmap that will require each Ministry of Health in member countries to implement and strengthen areas identified on the barometer as weak. She revealed that there were partnerships with colleagues at the African Academy of Sciences and African Union Development Agency to deliver the African Union's Science, Technology and Innovation Strategy for Africa 2024 (STISA-2024). She talked about TIBA's presence at the first ever Africa Pharma Conference held by the African Union Commission and colleagues at AUDA-NEPAD. Out of that, 10 conference recommendations were given, and they will be working together to see how to deliver with the expertise TIBA has. The team has also been working with the African Union Commission and AUDA-NEPAD to formulate a health and innovation strategy for Africa. They sent a team of TIBA PIs to the meeting, and they came up with a document from which they have drawn on the African Union Agenda 2063.



Dr. Janet Byaruhanga provided some background on the Health Research and Innovation Strategy for Africa. She informed delegates that it had already been adopted by the Specialised Technical Committee on Health, Population and Drug Control, which is a body that makes decisions on health on the continent. She spoke about the priority interventions they identified that the ministers of health approved:

- developing human capacity for sustained health research and innovation
- developing and strengthening regulatory systems, intellectual property and ethics that leverage the benefits of health research
- supporting the development and adoption of emerging and existing technologies to improve health
- developing a conducive environment for research and innovation, promoting sustained investments and financing mechanisms in research, development and innovation for health
- supporting the generation of new knowledge and its translation into policies and practice to improve health
- generating, warehousing, sharing and utilising data to inform and guide decision-making in terms of health delivery
- promoting the sustained investments and financing mechanisms in research, development and innovation for health

The implementation approach will draw in different stakeholders including decision-making bodies and coordination agencies. In addition, they are planning a stakeholders meeting to launch the strategy that has been adopted and talk about which areas need to be implemented first.



Professor Moses Chimbari also spoke about national community engagement activities and the importance of it as a catalyst for change in policies. He spoke about how it puts researchers in contact with important resources, increases the programme's influence and ability to achieve the desired change, and how it makes the programme more effective and sustainable. He also spoke about how NIHR requires researchers to maintain equitable partnerships with partners and engage and involve local communities and are strongly recommending Community Engagement & Involvement (CEI) in research teams championed by someone who has the skills to involve relevant LMIC communities. He acknowledged their need to work on empowering their communities and said, though it was difficult to tell their position on the CEI bar, they employed a PhD student who, with collaborative efforts, developed a framework for community stakeholder engagement. He spoke about the way forward, including the need to allocate resources to CEI, systematically documenting work in partner countries, defining what each partner country needs to do, and working closely with the monitoring and evaluation teams on their assignment.





EPIDEMIC PREPAREDNESS

WORK PACKAGE 6

EPIDEMIC PREPAREDNESS



Professor Mark Woolhouse spoke about how, at the University of Edinburgh, they have been engaged with emergency response to disease outbreaks. He cited work done in 2015 on the Ebola outbreak, including identifying the origins of the virus and its mode of transmission. Three problems with work they did surfaced, including the information not being published fast enough to deal with the epidemic at the time, external expertise trying to deal with the problem and its focus on just the Ebola outbreak and not on the health systems trying to deal with it and the impact on routine malaria screening. He mentioned the Ebola outbreak in DR Congo and how looking at other health problems going on in the country was important. He highlighted the importance of taking a multi-faceted approach to dealing with health problems.

Professor Woolhouse stressed TIBA's aim to strengthen local and regional capacity to respond to health emergencies, and he mentioned some of the workshops organised to help build this capacity. Beneficiaries of some of these capacity-building interventions presented briefs of the lessons learned.

Sylvester Languon (tibaGhana) spoke about the real-time genome sequencing workshop that was held in Accra, Ghana. He outlined the evolution of the mobile lab that was used to facilitate the workshop, which started off filling a truck, downsizing to an SUV and finally being able to fit in a suitcase, making it easy to carry around. There were 21 participants, representing 14 countries, with 13 from Africa and one from Asia.

Jeanne D'Arc (tibaRwanda) discussed the epidemiology of measles virus genotypes associated with outbreaks in Rwanda. The objectives of the project are to document the measles genotypes in Rwanda using the MinION sequencing technology, to understand and establish the transmission pathways and to illustrate factors associated with measles outbreaks. They have had protocols approved, project collaboration approval, started sample collection, and are currently working on writing and validation of a standard operating procedure on measles RNA extraction.

George Warimwe (tibaKenya) spoke about the *Rapid Impact Project*, which is characterising the endemicity and disease of Chikungunya virus infection in Kenya. He spoke about how the virus can be transmitted in two cycles: by the sylvatic cycle and through humans. The

objectives of the project include estimating the disease burden, clinical phenotypes and long-term incidence of its exposure, characterising the genomic diversity of detected cases and identifying risk factors underlying the virus exposure and clinical disease. He mentioned that it was very important to inform a vaccine efficacy trial design.

Professor Woolhouse concluded by detailing plans to complete the *Rapid Impact Project* on Chikungunya, complete real-time sequencing projects, and engage with international agencies.



FUNDERS' FORUM



A workshop, themed 'Role of Sustainable Partnerships for Research Leading to Improved Health Systems and Universal Health Coverage in Africa', chaired by Prof. Abdallah Daar of the University of Toronto (and Chair of TIBA's External Advisory Group), was held. It featured short presentations and a panel discussion from several speakers from funding agencies and industry partners.

The objective of this workshop was to discuss the future of partnerships for improving health research and its impact in Africa, building on a conversation on knowlegde partnerships that began at the Grand Challenges meeting held in London in 2016.

The workshop sought to share information from two perspectives. Firstly, the views of African stakeholders on what is needed and how, based on lessons learned, it should be delivered. Second, the views of regional and international funders on their strategic goals in Africa and how they saw these being achieved.

Discussions covered available financial aid to budding scientists, health systems coordination & partnerships, policy translation for sustainable development, international partnerships, corporate funding opportunities, industry-academia collaboration, funding agency engagement, long-term strategic planning to ensure sustainability of interventions, and government involvement in research funding & capacity-building.

Panelists included Professor Felix Dapare Dakora, President of the African Academy of Sciences; Dr. Simon Kay, Head of International Operations at the Wellcome Trust; Lena Leumer, spokesperson for Deutscher Akademischer Austauschdienst (DAAD); Alison MacEwen, UK Department of Health and Social Care; Dr. Elly Kourany-Lefoll, a representative from the Merck Global Health Institute; Access Bank representative, Ms. Kosiso Chinenye Iwugo; Professor James Smith, Vice Principal International, University of Edinburgh; Dr. Benjamin Djoudalbaye, African Centre for Disease Control & Prevention; Dr. Janet Byaruhanga, representative from AUDA-NEPAD; and Dr. Anthony Afum-Adjei Awuah, of the Kumasi Centre for Collaborative Research in Tropical Medicine.

EXTERNAL ADVISORY GROUP REPORT



Professor Abdallah Daar, Chairman of the TIBA External Advisory Group (EAG), presented the EAG report. He mentioned that the group reviewed the TIBA 2019 annual report to their funders. The funders were happy about the work that TIBA was doing, were impressed with the progress it has achieved, and the robust monitoring and evaluation system on their projects. The EAG also commended the Steering Committee on their work, saying they were happy with TIBA's engagements with their partners. They were impressed with the £2 million TIBA was able to raise in addition to the NIHR funding. They recommended that TIBA involve more West African and Central African countries, and Francophone and Lusophone countries. They advised that TIBA II diversify its funding sources. Finally, they recommended a more rigorous approach to influence policymaking across the continent.

NEXT STEPS & WRAP-UP

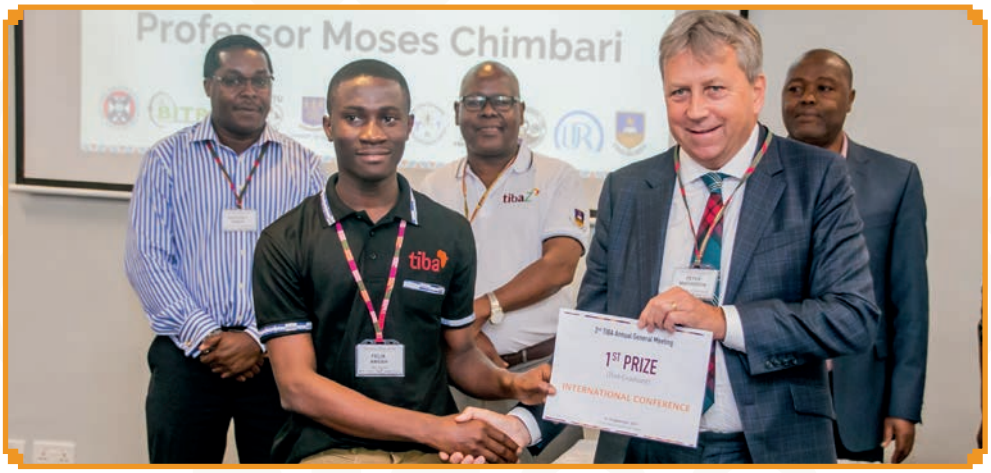
Professor Francisca Mutapi gave a summary of TIBA's next steps for the coming year. She explained that TIBA's plans are aligned with Africa's strategic plans. She said that TIBA's focus on training post-docs & PhD students is geared towards addressing the strategic needs highlighted in the African Development Index Plan. She also highlighted how TIBA's work is aligned with the sustainable development goals (SDGs), particularly SDG 3. She talked about TIBA's Work Packages, which, according to her, were developed to help as a road map to deliver those goals. She advised everyone to think about what part they could play in the delivery and expansion of TIBA II, to have an impact on the health and comfort on the African continent.

VOTE OF THANKS



Professor Peter Mathieson, Principal of the University of Edinburgh, giving the vote of thanks, said he was proud of the University of Edinburgh's record in fostering beneficial partnerships in Africa. He spoke about the optimism TIBA gave him for the development of Africa. He advised TIBA to focus on the young people, who, according to him, are the people that hold the key to the future for Africa.

Professor Moses Chimbari, after adding to the vote of thanks, announced the winners of the poster session, who were presented with certificates by Prof. Mathieson. Among postgraduate students, 1st Place winner, Mr. Felix Ansah, who earned 252 points, received a voucher to attend any conference of his choice anywhere in the world.



The first runner-up, Mr. Kennedy Mwai Wambui, who had 234 points, won a voucher to attend any conference within Africa. The second runner up, Hope Mataramvura-Muchatuta, who scored 207 points, won a voucher to attend any conference within Zimbabwe.





Among postdoctoral fellows, Dr. Tshidi Thaane won the only prize: a voucher to attend any conference of her choice anywhere in the world.



Professor Chimbari thanked the University of Ghana and tibaGhana for hosting, and the Provost of the College of Health Sciences for attending the meeting. “We would not be giving the right thanks to ourselves if we do not recognise NIHR for funding us and for coming out here and for giving us hope for TIBA II,” he said.

The meeting ended with a tour of the University of Ghana.

LIST OF POSTERS

NDOLO SEDIRENG *(Botswana)*
Optimisation of the SPME-GC-MS parameters for untargeted metabolomics of volatiles from Urine and Faecal samples for Schistosomiasis

GABAAKE KEBA *(Botswana)*
Analysis of Risk Factors for Schistosomiasis Re-Infection among School Age (7-12) Children of the Okavango Delta of Botswana after Intervention with Combination Prevention Package

ANSAH FELIX *(Ghana)*
Detection of *P. malariae* and *P. ovale* Species in Clinical Isolates using Cooperative Primers

MWAI KENNEDY *(Kenya)*
Integrated web tool for protein micro array data management and normalization

KAGABO JOSEPH *(Rwanda)*
Quantification and mapping of water contaminants and their association with the infectious diseases

NTIME NELSON *(South Africa)*
The relationship between child feeding practices and malnutrition among the Ingwavuma community, KwaZulu-Natal, South Africa

CHIKAFU HERBERT *(South Africa)*
Prevalence and determinants of physical activity practices in Ingwavuma Rural Community, KwaZulu-Natal

MULOPO CHANELLE *(South Africa)*
Contextual and psychosocial factors influencing collecting drinking water from a safe source

MAZIBUKO XOLISILE *(South Africa)*
The impact of schistosomiasis on language and cognitive skills in preschool children in Ingwavuma, South Africa

THAANE TSHIDI *(South Africa)*
Effects of Schistosomiasis on motor function in pre-school children of Ingwavuma, South Africa

MINDU TAFADZWA *(South Africa)*
Edutainment and inforgraphics for schistosomiasis health education in Ndumo area, Umkhanyakude, KwaZulu Natal

KALINDA CHESTER *(South Africa)*
Prevalence and risk factors of schistosomiasis and soil transmitted helminths in preschool aged children in rural KwaZulu-Natal, South Africa

ELSHAFIE AZZA *(Sudan)*
Characterization of transmission foci and accuracy of diagnostic tests for Malaria elimination

WANGOOLA ROBERT *(Uganda)*
Factors associated with persistence of Animal African Trypanosomiasis in Lango sub region, Northern Uganda

MADANHIRE TAFADWA *(Zimbabwe)*
Spirometric reference values for Zimbabwean children (7-13 years)

MATARAMVURA HOPE *(Zimbabwe)*
Frequency and Pattern of IgE-mediated sensitization to food allergens and evaluation of the allergens antibody test

VENGESAI ARTHUR *(Zimbabwe)*
Clinical utility of peptide micro-array diagnosis and surveillance of enteric and notifiable diseases in Zimbabwe



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