

MLW 2021 Annual Report

Malawi-Liverpool-Wellcome Clinical Research-Programme

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The Malawi Liverpool Wellcome Clinical Research Programme
Queen Elizabeth Central Hospital, Blantyre, Malawi



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MLW 2021 Annual Report

The Malawi Liverpool Wellcome Clinical Research Programme (MLW)
2021 Annual Report

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Executive Committee Chair's foreword

It is my pleasure to offer a foreword by way of introduction to the second MLW Annual Report. Malawi has seen extraordinary challenges in the last year, and the Kamuzu University of Health Sciences (KUHES) has been formed by Act of Parliament. In this time and context, it is with great pleasure that I observe the towering success of MLW, a research affiliate and constituent part of KUHES. MLW is big, strong, and ambitious in character, and as a KUHES affiliate, it is also distinctly Malawian, innovative in leadership and excellent in its science with impact.

First, regarding the scale and growth seen this year. This Annual Report shows exponential growth in each metric, and most importantly in the success and seniority of the trainees, equal numbers of whom are men and women. The Clinical Research Excellence and Training Open Resource (CREATOR) project is a natural expression of the ambition to build on this success.

Second, MLW is distinctly Malawian. More than 90 per cent of the staff are Malawian, and more importantly, there is steady growth in Malawian leadership to now include three quarters of the Senior Management Team and approaching half of the research group heads. This is recent and transformational change which is continuing at pace. The innovation evident in the devolved leadership of science, research and academic standards, operations, culture, and partnership are showing immediate dividends.

Third, the science of MLW is stunning. National accolades from the President's office downwards have appreciated contributions in COVID response, salmonella vaccines, malaria vaccine, and cryptococcal meningitis care. The ambition of MLW to integrate with the national research agenda and to partner with the Public Health Institute of Malawi and other public institutions is well understood. It is good to see the MLW Themes aligning both to the strategic agenda of the nation, and of KUHES.

As Vice Chancellor of KUHES, I have several challenges for MLW in the next years. I expect MLW to engage fully both with the new Schools that constitute KUHES, and with sister institutions such as the Malawi University of Science and Technology (MUST) and the Lilongwe University of Agriculture and Natural Resources (LUANAR). There is an exciting interactogram in the Report (p 18) that shows how research groups work together – what does the Malawi interactogram look like? I would also challenge MLW on trainee recruitment in the region – is the MLW/KUHES recruitment reach extending to regional partners facing similar health challenges? Malawian science must not be insular in outlook.

As Chair of the MLW Executive Committee, I congratulate MLW on an outstanding Annual Report. I look forward to working with the University of Liverpool, Liverpool School of Tropical Medicine, and Wellcome Trust on that Executive Committee. We will work together with MLW senior leadership to build on this success.

Professor Mac Mallewa
Vice Chancellor, Kamuzu University of Health Sciences.



Director's welcome

MLW is twenty-five years old and I welcome you to this second annual edition of the Annual Report. It is a wonderful document, sharing the joy, challenges, successes and hopes of a wonderful community committed to the improvement of human health.



Our vision and partners

MLW has a vision of science driving health and wellbeing in Malawi. This is bold, ambitious and demanding as Malawi is among the least developed economies in the world, with severe challenges related to population density, climate change and environmental degradation and nutrition, as well as endemic diseases including HIV, TB and malaria. MLW scientists have courage, commitment, energy and belief – these combined with excellent funding, facilities and partnerships allow us to achieve great things.

Our major partners in Malawi, now as for the last 25 years, are the Ministry of Health and the Kamuzu University of Health Sciences (KUHeS, formerly University of Malawi College of Medicine). Our major international partners are the Liverpool School of Tropical Medicine and the University of Liverpool. Our major grant sponsor and core fund provider throughout these 25 years has been Wellcome. I am reminded this year that Michael Chew at Wellcome has walked with us through the whole journey. Thank you.

Our mission

The MLW Mission is to conduct high quality research to improve health and to train the next generation of researchers and leaders. Our partners are critical in delivering this mission along with many strong collaborators, listed in the Appendices.

Research is nurtured in six Themes: Population Health; Social Science; Maternal, Neonatal and Child Health; Vaccines; Clinical and Experimental Medicine; and Infection Biology. These Themes catalyse the interactions between our 16 Research Groups, 6 Associate Research Groups and 4 Research Support Units. Training in MLW is from junior scientist to Group Head and from operations staff recruit to Department Head. Training is mentored in our Research Groups and Departments, supported by the Training Committee. Nine of the Research Group Heads as well as the Director have previously been MLW trainees.

2021 Annual Report

This document describes the success, current activity and plans of the Research Groups at MLW. It seeks to be informative and inspirational, both for junior scientists who might choose to join MLW, for seniors and for collaborators. I hope you enjoy it as much as I do.

Best wishes

Stephen Gordon

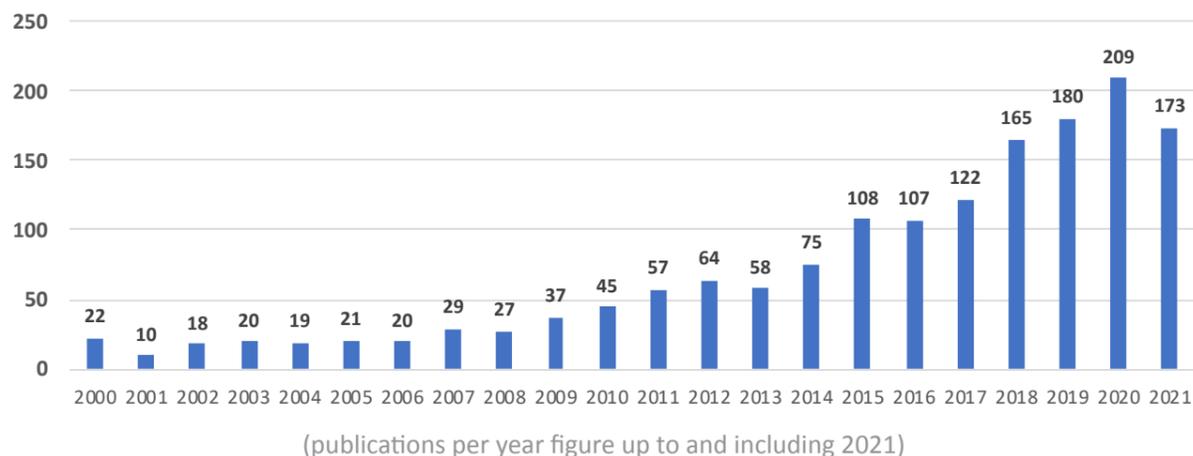


MLW team members aim to improve the health and wellbeing of Malawians and people around the world, conduct research to benefit health, and train the next generation of science researchers. © MLW 2021.

MLW growth and trajectory

MLW is an outstanding success, showing achievements in science, health improvement, careers, and international reputation. MLW has become the largest research institution in Malawi with over 700 members and there is huge expectation of what we can achieve to change the health and well-being of people in Malawi and around the world. 2021 has been the year of greatest national impact, highest national profile and yet some of the greatest challenges ever faced by the programme in terms of international isolation, potential threats including COVID, and awkward communication. 2022 offers the opportunity to build on success, learn from mistakes and move forward with anticipation.

MLW Total Publications 2000 - December 2021



Leadership reform in 2021-22

During 2021, a strong collaborative leadership between the Programme Director (Stephen Gordon), Deputy Director (Henry Mwandumba), Associate Director (Janelisa Musaya) and Chief Operating Officer (Aubrey Chalira) has developed to bring both additional strength and Malawian contextual thinking to MLW direction and planning. This has allowed us to bring the input from two Strategic Workshops (2020 and 2021), along with stakeholder input and a Culture Review (2021) to bear on reform of the Executive Committee, Senior Management Team, Research Strategy Group and Heads of Departments planned for 2022.

The Executive Committee, chaired by the Vice Chancellor of the Kamuzu University of Health Sciences (KUHeS), will continue to oversee the MLW Programme. This Committee has more work now than ever and will increase their meeting frequency as well adding new members in 2022.

The Programme Director will continue to chair the Senior Management Team, focusing on the CREATOR project, governance reform, continued growth of MLW and alignment to national priorities as a Malawian institution. The Deputy Director will chair the Research Strategy Group, as well as being tasked with managing MLW scientific direction and academic standards. The Associate Director will continue to chair the Culture Review and will also lead MLW in discussion regarding relationships with major partners, particularly taking advantage of the new opportunities afforded by the formation of the Kamuzu University of Health Sciences. As our operations continue to grow, the Chief Operating Officer will build on previous work and lead the Heads of Departments in making a greater number of infrastructural decisions, particularly focusing on value and performance.

Themes in 2022

MLW is big and exciting, but hard to explore as a newcomer! Themes will give us the means to explain and celebrate our science both internally and to the wider scientific community. The development of Theme identity and working will be a major part of the energy of 2022, which will be welcome after the isolated and online nature of 2021. The current structure and relationships of Themes and Groups as they exist now are described below.

Our vision remains the same – improving health and wellbeing – as do MLW’s two missions and aims – research to benefit health and training the next generation. We are a strong team, united in a common purpose and valuing each other as we make a difference in Malawi.

Thank you all again for contributing so much to the MLW story.



Authored by Stephen Gordon, Henry Mwandumba and Janelisa Musaya. (Director, Deputy Director and Associate Director)



Training Committee co-Chair Dr Kondwani Jambo (*right*) chatting to KUHeS and MLW trainees at the first trainee social event, 1 Oct 2021. © MLW 2021.

Training and trainees at MLW

Introduction

MLW and KUHeS share a mission of training the next generation of researchers and scientific and Operations leaders, and therefore co-Chair the MLW-KUHeS Training Committee to plan and oversee this work. The Training Committee achieves its goals through nurturing trainees' skills and knowledge and by supporting candidates through five academic training levels: Pre-Masters, Masters, Pre-PhD, Doctoral and Post-Doctoral levels. Training support is through the MLW CORE grant awarded to MLW by Wellcome and from other funders through research projects.

For the period 2018-2023, the MLW CORE training grant was increased to £1.8million (from a previous £0.8 million in the previous 5 years), to support the career growth of trainees in the pipeline and support career development of Operations staff. Two-thirds of this budget (~£1.2million) was allocated to career development of Science/Research trainees, while the rest of the budget (~£0.6million) was allocated for the Operations teams at MLW/KUHeS.

Furthermore, the funds cover costs for Leadership and Management training and mentorship.

Metrics of success

We have more trainees than ever before (Figure 1 and 2 from Training report below), the majority being Malawian with equal numbers of men and women.

1. Trainees in The Pipeline

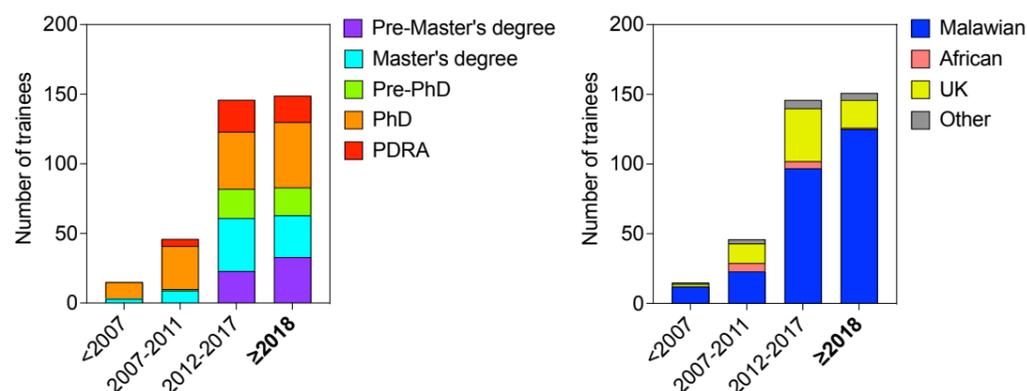
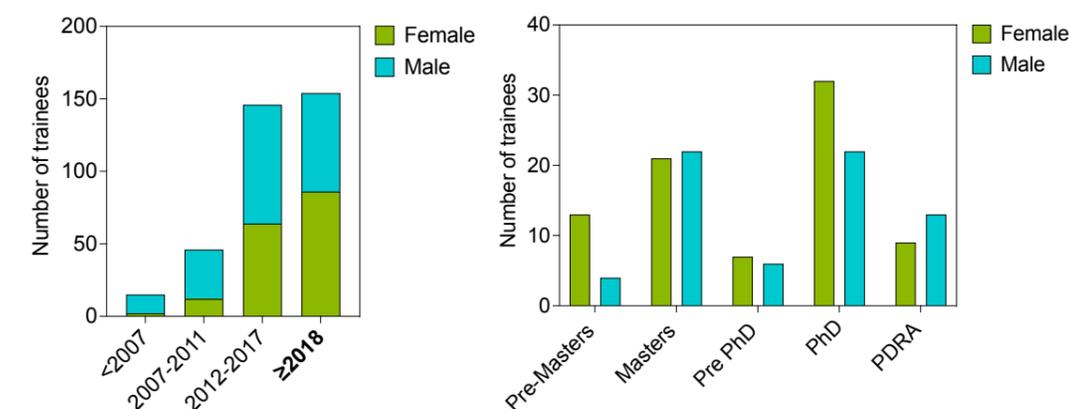


Figure 1. a) Trainee numbers by academic level. The total number of trainees in the current training period (2018-2023) has already equaled that from the previous training period (2012-2017), with 2 years to go before the end of the current period. **b) Trainees by nationality.** The number of Malawian trainees in the current training period (2018 – 2023) has already surpassed that from the previous training period (2012 – 2017).

2. Trainees by gender

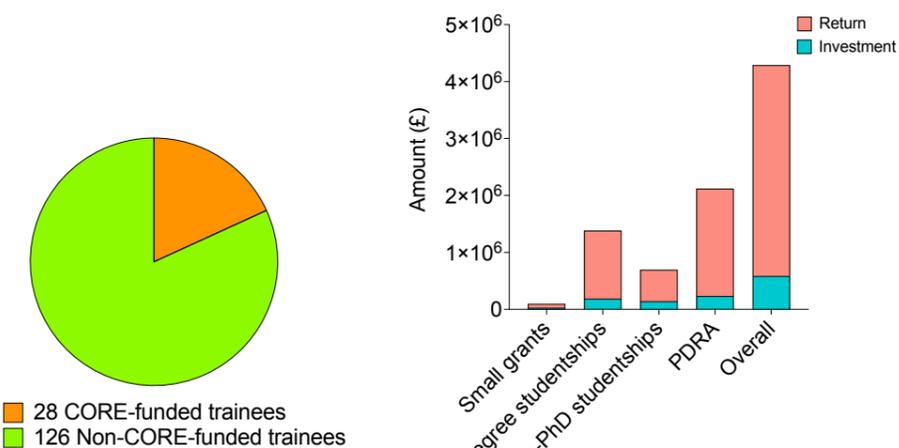
Figure 2. a) Trainees by gender. There are more females than males in our current training pipeline (2018 – 2023), reversing the status from the previous training period (2012 – 2017). **b) Trainees by gender at different training levels.**

The Training Committee are appropriately proud of success in 62% of Fellowship applications. Further, the Core-funded Training Department and team have leveraged very substantial additional funding from large projects in terms of additional studentships and projects. For every Core funded student, there are approximately 5 trainees funded from other sources.



3. Return on Investment

Figure 8. a) Funding source. For every 1 CORE-funded trainee, there are approximately 5 non-CORE-funded trainees, who also include external Wellcome-funded fellowships. **b) Financial Return on Investment.** The overall Return on Investment (ROI) of **534%** i.e. for every £1 invested in CORE-funded trainees in the current training grant (2018 – 2023), we have generated £6 from Wellcome and non-Wellcome funding.





The Clinical Research Excellence and Training Open Resource. © MLW 2021.

CREATOR Project and Malawi Clinical Science

Why CREATOR?

The vision

The Malawi Liverpool Wellcome Clinical Research Programme (MLW) strives to be the best research institute in any low-income country world-wide and now wishes to make a step-change in the scale of postgraduate specialist training of doctors and scientists together.

The core purposes

The CREATOR building will accommodate a 30% increase in research activity over the next ten years from the existing £15m per year activity. This will be combined, for the first time, with postgraduate specialist medical education by engaging with hospital academic departments and 140 or more postgraduate clinical and non-clinical research trainees.

The value of CREATOR for Malawi and the region will be a step-change in the scale of clinical research and a reversal of the accepted norm of trainees leaving Malawi and the region to source high quality specialist education.

Momentum towards the CREATOR vision

Expanding excellence in Research and Clinical Leadership

MLW is expanding rapidly in scale, scope and impact, in part driven by a doubling of Core budget but also by substantial grant, publication and discovery success. Expanding scale at MLW can be measured in the 75% increase in staff over the last 2 years (429 to 750).

Supportive local clinical leadership has developed in all the clinical departments of the Queen Elizabeth Central Hospital (QECH). These current leaders all trained in specialist skills outside Malawi, often in LSTM, and returned to take up College and Ministry of Health roles.

How will the CREATOR building enable research and education?

Laboratories, Project Rooms and Research Support Units

We will keep our Science world-leading in quality as advised by our International Scientific Advisory Board. We will ensure that the Science is relevant by scrutiny from our Malawi Scientific Advisory Board. The Clinical, Data, Statistics and Lab Research Support Units (RSU) in MLW currently manage large clinical trials to the highest standards supported by >200 staff. There is a need for expansion to include early Phase (discovery) trials and to engage more fully with the needs of clinical departments.

The planned site of the new CREATOR building (*below*) offers great co-localisation with our existing laboratories, as well as the hospital and research affiliates particularly the Malaria Alert Centre and Blantyre Malaria Project.

Training Open Resource – library, teaching, talking and working

The Training Open Resource on the ground floor will be an exciting learning and teaching space that allows free and open access to excellent training resources. As well as library, skype and discussion facilities suitable for future leaders and specialists, visiting specialists will augment the local faculty to provide an international academic milieu. The details of the training to be offered are the subject of current consultation to include input from all interested parties (this consultation is led by the MLW Programme Director and called the CREATOR Project).



Research and study spaces

The first floor is designed to accommodate the Postgraduate Resource Centre, a centre that allows for self-learning of a high degree, a modern library to support this self-learning space and lots of quiet learning areas. The Deputy Director is leading the design of this space.

The second and third floors are research offices designed to promote Clinical Research Excellence. Advanced epidemiology and large clinical trial support will be accommodated in open plan offices. Several Theme Leads and the Training Committee Chair have designed these spaces.

Single-cell transcriptomics, modern imaging and rapid pathogen sequencing will be accommodated in the new 4th floor laboratory. The Lab Steering Committee has designed this space

Total investment and timeline

We have secured land and £8.5m from Wellcome, University of Liverpool and the Liverpool School of Tropical Medicine. We have approved drawings, local approvals and will build over 90 weeks starting in December 2021. We will open in 2023.

Policy at MLW



Rhona Mijumbi-Deve, Head of the MLW Policy Unit. © MLW 2021. Photographer: Pauline Mlogeni.

Introduction

To achieve health impact, researchers must answer important, relevant, apposite questions and these important discoveries must be translated into policy promptly. We are delighted to welcome Rhona Mijumbi-Deve to lead on delivering this impact as Head of the MLW Policy Unit.

New Head of Policy Unit

Rhona Mijumbi-Deve trained as a medical doctor and graduated 20 years ago. She then worked as a clinician in Neurosurgery and Paediatrics in Uganda's capital, Kampala. She later did a Master's in Epidemiology and Biostatistics and another in International Public Health majoring in Health Policy, which began her quest to understand and improve the science-policy nexus. She holds a PhD in Health Policy. She has been working in Public Policy for a decade now. Her special interests are in the nexus of science and policy especially in urgent/emergency contexts, and Science and diplomacy and health security. She has been instrumental in the change of the landscape of evidence use for policy in the African region. One of her assignments before coming to MLW was building a case for investment in health sciences research in Africa, work commissioned by and for Wellcome, and that she executed as a Research Associate at the London School of Economics and Political Science's Health Policy Department.

Developments in 2022

Rhona joins MLW as part of MLW's effort to develop its research to policy/practice portfolio. At MLW, she will be looking to foster and strengthen MLW (and its work)'s impact and influence at different governance levels - national, sub-national, regional and global. She will be looking to build both individual and institutional capacity, and improve networks for researchers, knowledge brokers, and policy stakeholders to engage relevantly and meaningfully around pertinent policy and research issues. She will build the MLW Policy Unit and enhance its profile to be able to support evidence-informed policy and decision-making activities in Malawi and the region. She will also ensure that there are systems and structures in place that permit and support the knowledge transfer space. In addition, she will be looking to generate evidence around the science-policy nexus in Malawi and grow the health system and policy research portfolio at MLW.

Research Groups and Associate Groups

Definition

Research Groups at MLW are led by Malawi-resident scientists at Principal Investigator level and provide mentored support for students and trainees at all levels. Each Group has a subject relevant name, a Group Head (with a Deputy Group Head and admin support), a translational science plan, grant funded research, a pipeline of trainees (Interns, MSc, PhD, Postdoc, Postdoctoral Research Associates, Associate Group Heads) and engagement with community (local public, College of Medicine (CoM), nation including leadership, international policy). New Groups are established when there is sufficient momentum in each of these domains as agreed with the Director. Until that time, or in the event of activity reduction, the group is described as an **Associate Group** and is linked with an existing Research Group to support the Associate Group Head.

Selection and management of new projects

New projects (grants and studentships) are approved by the Research Strategy Group (RSG) which is chaired by the Deputy Director and composed of Group, Associate Group and Research Support Unit Heads along with Operations representatives. All projects are managed within Research Groups.

Finding out about ongoing projects

Project Progress is our weekly corporate meeting (face to face and online) to support our trainees' academic environment.

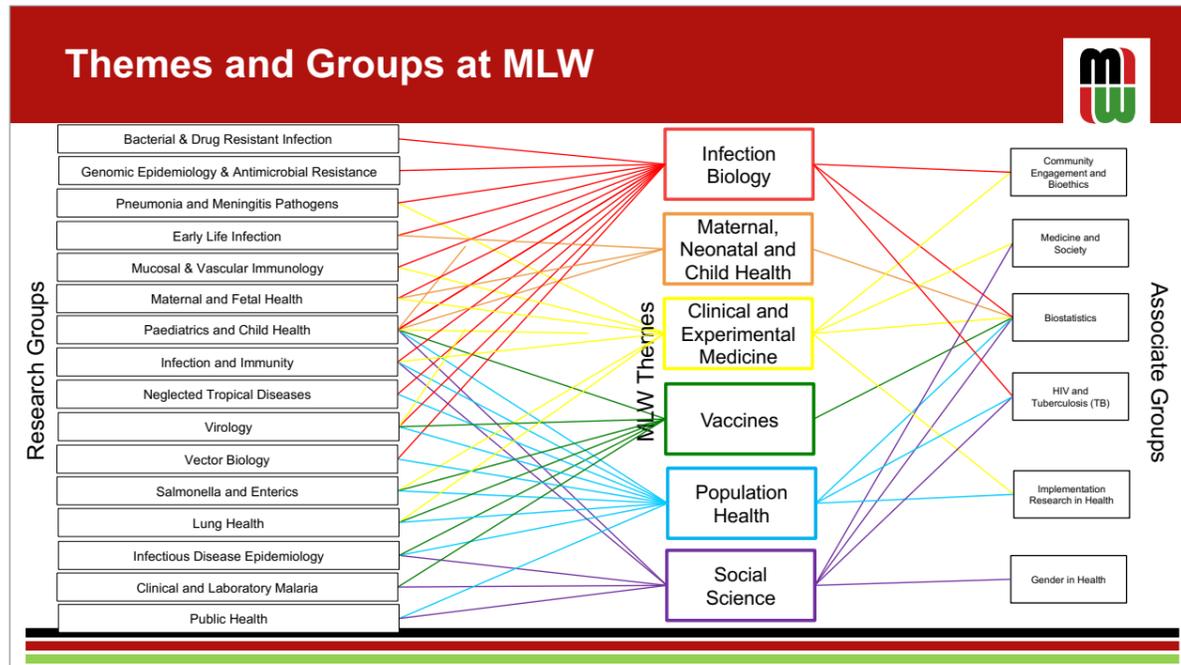
Cutting Edge is the platform offered to local and visiting experts to showcase their wider subject and specific interactions with MLW. These activities are now managed as part of the academic life within our 6 Themes.

Celebration Lectures are when we invite recently promoted Professors or Associate Professors in MLW to give an autobiographical and scientific account of their success. These lectures are open to all and occasions of great joy.



Celebration Lectures by Henry Mwandumba (*left*) and Melita Gordon. © MLW 2021.

MLW Research Themes



The relationships between Themes, Research Groups and Associate Groups at MLW. © MLW 2021.

Definition of a Theme

MLW Themes are the means by which we explain our science to each other and the outside world, and celebrate our successes. Themes are science-driven groups of staff of all cadres and skills, coming together to promote research in a specific area. Theme members will include Research Group members, Operational Department staff (especially Labs, Clinical, Data), and collaborators.

Roles of a Theme include:

- Strategic group within MLW to improve research and training in a specific area of study
- Research Group collaboration on projects
- Enhancing MLW's ability to lead and participate in consortia
- Senior trainee mentorship for career progression, including equality and diversity
- Improved grant writing by better research questions and larger capacity
- Peer support and mentoring
- Better visibility for a wider range of MLW staff in the science, allowing department Core staff a good fit into a broad theme discussion.
- Theme level Project Progress presentations to give trainees presentation exposure
- Cutting Edge talks to promote the specific area of study in the wider MLW
- Away days to build Theme cohesion and sense of belonging
- Short training courses
- Monthly meetings to democratise decision making
- Representation on Senior Management Team (SMT) and other leadership committees (Lab, Data, Policy)

MLW Research Themes and Leads



Infection Biology

Leads: Henry Mwandumba (*left*) and Nick Feasey

The Infection Biology Theme brings together research groups with a wide range of expertise in pathogen surveillance, microbial genomics, immunology, virology, vaccinology and antimicrobial resistance linked to the cutting-edge laboratory facilities at MLW. Our research bridges the gap between the laboratory Leads,

from left: Peter MacPherson, Anja Terlouw, Rhona Mijumbi, Marc Henrion, Marlen Chawani and, not shown, Marriott Nliwasa and Augustine Choko. clinical spheres, promoting research excellence and leadership in the biological science of infection in relation to health.



Maternal, Neonatal and Child Health

Theme Committee Chair: David Lissauer

The Maternal, Neonatal and Child Health Theme is a collaborative network of scientists at MLW and associated institutions, working together to support each other and enhance our research on mothers, neonates, children and adolescents. We have a Theme leadership committee (Chair David Lissauer) as we think this will best enable shared leadership across maternal, neonatal and child health, promote gender equity, and provide opportunities for supporting development of early career researchers.

The Theme has received external support and expressions of interest for collaboration from researchers working in Maternal, Neonatal and Child Health at MLW, Kamuzu University of Health Sciences (KUHeS), Malawi University of Science and Technology (MUST) and the Ministry of Health (MoH).



Clinical and Experimental Medicine

Lead: Jamie Rylance

This Theme is of interest to many across disciplines and for those with inter-disciplinary interests including diagnostics, physiology, data, health systems, health economics, policy, and clinical specialities. It is a key part of many existing Groups including Maternal and Fetal Health, Lung Health, and Paediatrics and Child Health, but also has unique opportunities at MLW including human challenge models, research wards (adult and paediatric) and early phase trials led through the Clinical Research Support Unit. The Clinical and Experimental Medicine

Theme will align closely with the activity and priorities in the hospital and medical school and is one of the natural foci of the Clinical Research Excellence and Training Open Resource (CREATOR) project. In particular, this Theme lends itself to educational offerings as both short and longer format academic training for local and international students (e.g. Respiratory MSc, ultrasound in LMIC).

Vaccines

Leads, *from left*: Melita Gordon, Latif Ndeketa, Deborah Nyirenda, Khuzwayo Jere, Todd Swarthout



The Vaccines Theme will consolidate and get extra value from participating MLW Groups with expertise in:

- Vaccine epidemiology studies;
- Vaccine clinical trial design (all phases, including controlled human infection model (CHIM) studies);
- Vaccine introduction & roll-out strategies;
- Post-implementation vaccine impact assessment studies;
- Patient and participant involvement.

We will be highly complementary and collaborative with other Themes focusing on pathogens, antimicrobial resistance (AMR), immunology and immunity and public health impact. We aim to facilitate synergy, not to replicate other Themes' areas of activity. The same applies to controlled human infection model experimental work and early phase studies, and to health policy and economics. Our emphasis will therefore be on:

- Adding scientific value from our activities and networks
- Attracting and leading larger collaborative grants and consortia in these areas
- Supporting training and capacity development.

Population Health

Leads: Peter MacPherson (*left*) and Anja Terlouw



The Population Health Theme will have as collaborative a strategy as possible, including input from the early- and mid-career researchers not currently aligned to the Population Health Theme. Through interdisciplinary collaboration we will focus within MLW and in Africa on delivering high quality, methodologically innovative epidemiological and interventional population-based research and training that will directly translate into policy to address the major public health priorities in Malawi and other low-income settings.

Specifically, we will:

- Support an emerging pipeline of Malawian research leaders in population health methodologies
- Support collaborative funding applications to deliver excellent population health research
- Advocate within MLW for Population Health strategic appointments, resourcing, and infrastructure;
- Develop and advance MLW and global expertise in population health research methods relevant to low-income settings, particularly:

- o High resolution surveillance, epidemiology, and geospatial statistics to inform better-targeted delivery of health interventions
- o Randomised trial designs, implementation and analysis methods to rapidly evaluate promising health interventions
- o Health economics, policy and implementation science to scale-up interventions and measure impact.

Social Science

Rotating leads (*from left*): Moses Kumwenda, Deborah Nyirenda, Ellie MacPherson



This Theme is a cross-cutting and multidisciplinary team of social scientists from MLW and affiliated research institutions working together to advance the field of health-related social sciences. The Social Science Theme will create a safe space where social science researchers can develop independent research, provide peer and other support to upcoming social science researchers, and support other Themes and groups interested in employing social science research methods.

Further, the Theme will:

- Attract, train and retain world-class social scientists working on health issues;
- Catalyse interest in social sciences research careers among junior researchers;
- Strengthen research collaboration with local, regional and international social science researchers;
- Promote visibility of social science research within and outside MLW; and
- Support post-graduate research methods training at KUHeS.

Research Group responsibility for projects and trainees

Research Groups plan their own strategy, hold and manage grants, recruit and train students and staff, invite visitors, engage with community, and be supported where needed and when feasible by Core Departments. The Director and Deputy Director annually review how each Group performs in:

- Scientific progress, evidenced by papers, grants, degrees and other markers of achievement;
- Strategic thinking, particularly identifying big questions, supported by International Scientific Advisory Board (ISAB)/ Malawi Scientific Advisory Board (MSAB);
- Educational opportunity and career development within the Group;
- Good group administration of grants and studentships;
- Hosting visitors, the Cutting Edge platform, Project Progress, and community engagement events;
- Policy, translation, Internal, external and science communications, and community engagement;
- Contributions to MLW's academic life, including teaching and training.

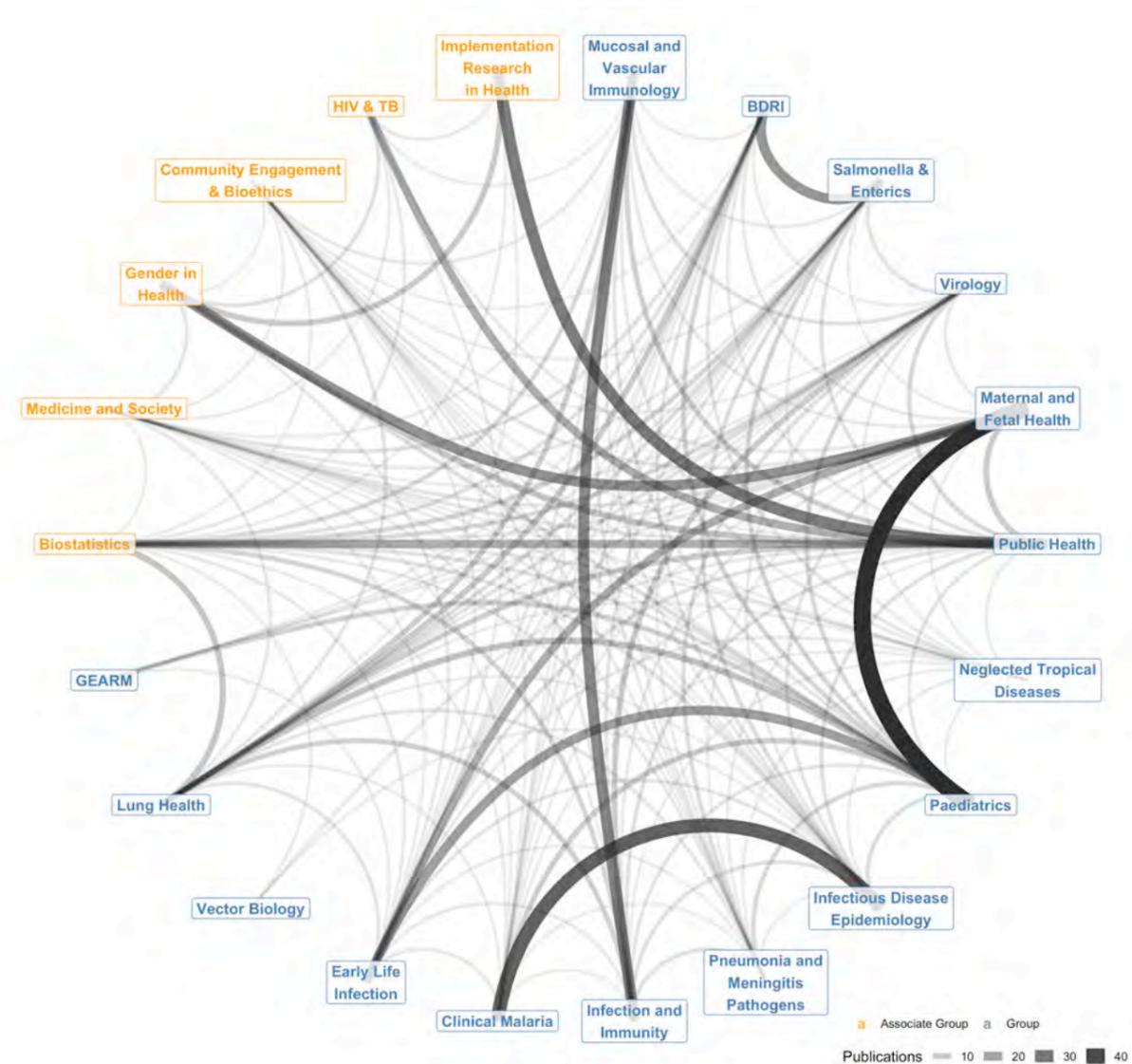
Roles of Group Heads in MLW

Group Heads will be responsible to the Director for the Group's conduct in all aspects of this work. They will ensure good linkage of their Group with Themes and meet when needed with the Director to discuss all aspects of the Group's scientific work. Group Heads are expected to:

- Meet regularly with the Senior Finance Manager to review grant financial governance;
- Present students at Project Progress, encourage students to attend Project Progress and attend it themselves
- Attend Cutting Edge and provide speakers for Community Engagement seminars once or twice per year as part of the life of the Themes
- Invite the Director, Deputy Director and Associate Director to attend team meetings on a regular basis – these can be Group meetings, or wider Theme events featuring the work of the Group
- Associate Groups will work in close association with the direction and support of a Research Group with the stated ambition of maturing to a full Research Group.

Group interactions

Synergy between Groups and Associate Groups is encouraged by Theme meetings, with results demonstrated by co-authored papers, co-supervised students and collaborative projects. Our MLW Research Group Interactogram (*below*) shows these interactions in publication numbers. Each edge is one paper, with authorship from both of the linked Groups. Thicker edges show linkages of 10 or more papers as per the key.



MLW Research Groups and Associated Groups





Mucosal and Vascular Immunology Research Group Lead Professor Henry Mwandumba (standing, 7th from right) and his team members. © MLW 2021. Photographer: Alick Chimzere.

Mucosal & Vascular Immunology

I. Overview

Led by MLW Deputy Director Professor Henry Mwandumba, supported by Dr David Mzinza (Deputy Head) and Evelyn Kossam (Administrator), the Mucosal & Vascular Immunology Group's research on tuberculosis (TB), fungal meningitis, human immunodeficiency virus (HIV), and vascular diseases has advanced our understanding of the impact of HIV-1 infection on host immunity and predisposition to disease in humans, and supported the strategic implementation of TB preventive therapy to reduce the high burden of HIV-associated TB in sub-Saharan Africa.

Made up of closely interacting teams that conduct innovative, impactful clinical research, the Group is one of Africa's leading immunology research programmes, training scientists and clinicians to equip them with the skills necessary to address global health challenges.

The Group's respiratory studies focus on mapping and characterising the functions of lung immune cell subsets that play key roles in defence against infections such as TB and pneumonia. Findings from these studies will help develop novel strategies to enhance lung immunity and improve control of respiratory infections and HIV-1. Currently, Mucosal & Vascular Immunology Group focuses on activities to answer research questions involving:

Lung macrophage ontogeny, heterogeneity and Mycobacterium tuberculosis

Do the ontogeny and phenotype of human lung macrophages determine their susceptibility and response to infection? Can this knowledge inform a systematic approach to control respiratory infections such as *Mycobacterium tuberculosis* (Mtb)? Answering these questions has led the Group to:

1. Compile a phenotypic and functional roadmap of phagocyte populations in healthy individuals' lungs;
2. Determine how respiratory infections perturb lung phagocyte populations' phenotype and function;
3. Quantify anti-microbial activities of human bronchoalveolar lavage (BAL) phagocyte populations *ex vivo* using fluorescent readouts of Mtb fitness and transcriptome profiling approaches;
4. Identify soluble modulators of host macrophage function using omics approaches;
5. Assess candidate genes and pathways in successful control of intracellular Mtb infection using Loss of Function and Gain of Function approaches and host-directed therapeutics.

Persistence of HIV-1 in the lung

The Group has used transcriptome profiling of HIV-1-infected BAL cells to characterise the molecular determinants of HIV-1 persistence in infected human macrophages, then applying this understanding to HIV-1 eradication and cure strategies. Using siRNA and synthetic mRNA approaches, the Group has validated candidate genes and pathways involved in successful control of intracellular HIV-1 infection.

HIV-1-associated vasculopathy

Reducing the burden of HIV-associated cardiovascular and cerebrovascular diseases has led the Group to focus on defining the drivers and mechanisms responsible for HIV-1 and ART-associated chronic immune activation and vascular inflammation using immunophenotyping and transcriptome profiling of peripheral blood leukocytes.

Group members have played key roles in bridging the gap between the laboratory and clinical spheres, bringing a critical clinical perspective about major health challenges in low-income countries like Malawi.

A vibrant, productive, gender-balanced group of basic and clinician scientists, the Mucosal & Vascular Immunology Group has expanded its activities in basic and translational research and established new collaborations since 2020. The Group's contributions to science worldwide have been recognized with international speaking engagements, membership of national and international expert committees, and prestigious awards, such as the Royal Society Africa Prize 2019 awarded to Henry Mwandumba.



The Clinical team ready to recruit study participants in the Clinical Investigation Unit. © MLW 2021. Photographer: Alick Chimzere.

Group members are active in academic life at MLW and Kamuzu University of Health Sciences (KUHeS). David Mzinza is a member of the Laboratory Steering Committee and convenes MLW project progress meetings.

Henry Mwandumba is a member of the Senior Management Team and the MLW COVID-19 Committee, Research Strategy Group Chair and Clinical Investigation Unit Lead.

II. Scientific achievements 2021

The Mucosal & Vascular Immunology Group continues to be very productive, with 9 papers published in 2021. Significant results by research question in 2021 include:

Lung macrophage ontogeny and Mycobacterium tuberculosis

- Human airway macrophage subsets are predominantly of embryonic origin and respond divergently to Mtb infection.

Persistence of HIV-1 in the lung

- A high sensitivity novel HIV-1 reporter assay can detect single HIV-infected macrophages from a bulk population of cells.

HIV-1-associated vasculopathy

- Inflammatory pathways among people living with HIV in Malawi differ according to socioeconomic status.

III. Top 5 publications since 2020

These are the most important of the 21 papers published in scientific journals since 2020 by the Mucosal & Vascular Immunology Group (group member names in **bold**):



Thomas Nyankalwa and Carol Gondwe, Mucosal and Vascular Immunology Research Group research nurses, checking equipment in the Clinical Investigation Unit. © MLW 2021. Photographer: Alick Chimzere, Creative Works.

1. Single cell analysis of *M. tuberculosis* phenotype and macrophage lineages in the infected lung. Pisu D, Huang L, Narang V, Theriault ME, Le-Bury G, Lee B, Lakudzala AE, **Mzinza DT**, **Mhango DV**, **Mitini-Nkhoma SC**, Jambo KC, Singhal A, **Mwandumba HC**, Russell DG. *J Exp Med*. 2021 Sept 6;218(9):e20210615. doi: 10.1084/jem.20210615. PMID: 34292313.
2. Intrapulmonary pharmacokinetics of first-line anti-tuberculosis drugs in Malawian patients with tuberculosis. McCallum AD, Pertinez HE, Else LJ, Dilly-Penchala S, **Chirambo AP**, **Sheha I**, **Chasweka M**, **Chitani A**, **Malamba RD**, Meghji JZ, Gordon SB, Davies GR, Khoo SH, Sloan DJ, **Mwandumba HC**. *Clin Infect Dis*. 2021 Nov 2;73(9):e3365-e3373. doi: 10.1093/cid/ciaa1265. PMID: 32856694.
3. Longitudinal pharmacokinetic-pharmacodynamic biomarkers correlate with treatment outcome in drug-sensitive pulmonary tuberculosis; a population pharmacokinetic-pharmacodynamic analysis. Klopogge F, **Mwandumba HC**, Banda G, Kamdolozi M, Shani D, Corbett EL, Kontogianni N, Ward S, Khoo SH, Davies GR, Derek J. Sloan DJ. *Open Forum Infect Dis*. 2020 Jun 6;7(7):ofaa218. doi: 10.1093/ofid/ofaa218. PMID: 32733976.
4. Inflammatory phenotypes predict changes in arterial stiffness following ART initiation. **Kelly C**, Tinago W, Alber D, Hunter P, Luckhurst N, Connolly J, Arrigoni F, Abner AG, **Kamng'ona R**, **Sheha I**, **Chammudzi M**, Jambo KC, Mallewa J, Rapala A, Heyderman RS, Mallon WG, **Mwandumba HC**, Walker AS, Klein N, Khoo SH. *Clin infect Dis*. 2020 Dec 3;71(9):2389-2397. doi: 10.1093/ciaa186. PMID: 32103268.
5. TzM-gfp cells: a tractable fluorescent tool for analysis of rare and early HIV-1 infection. Gludish DW, Boliar S, Caldwell S, **Tembo DL**, **Chimbayo E**, Jambo KC, **Mwandumba HC**, Russell DG. *Sci Rep*. 2020 Nov 16;10(1):19900. doi: 10/1038/s41598-020-76422-6. PMID: 33199722.



The Group's Laboratory team. © MLW 2021. Photographer: Alick Chimzere.

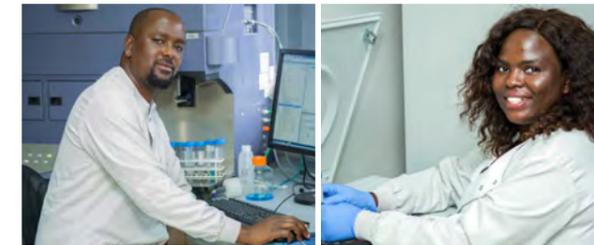
IV. Translation

Mucosal & Vascular Immunology Group translational pathway projects include:

- Developing a fluorescent in situ hybridization (FISH) assay to detect cell-associated HIV. The Group are exploring using the FISH assay to identify HIV reservoir cell populations in blood and tissues during suppressive ART;

- Establishing an ex vivo model of *Mtb* infection of primary human lung macrophages. The Group are using this model to test repurposed drugs with potential as macrophage-host-directed therapeutics to enhance the antimicrobial activity of host macrophages and augment anti-TB treatment;
- Conducting the AMBIsome Therapy InductionOptimisation (AMBITION) trial to evaluate a simplified HIV-associated cryptococcal meningitis treatment regimen.

V. Trainees in 2021

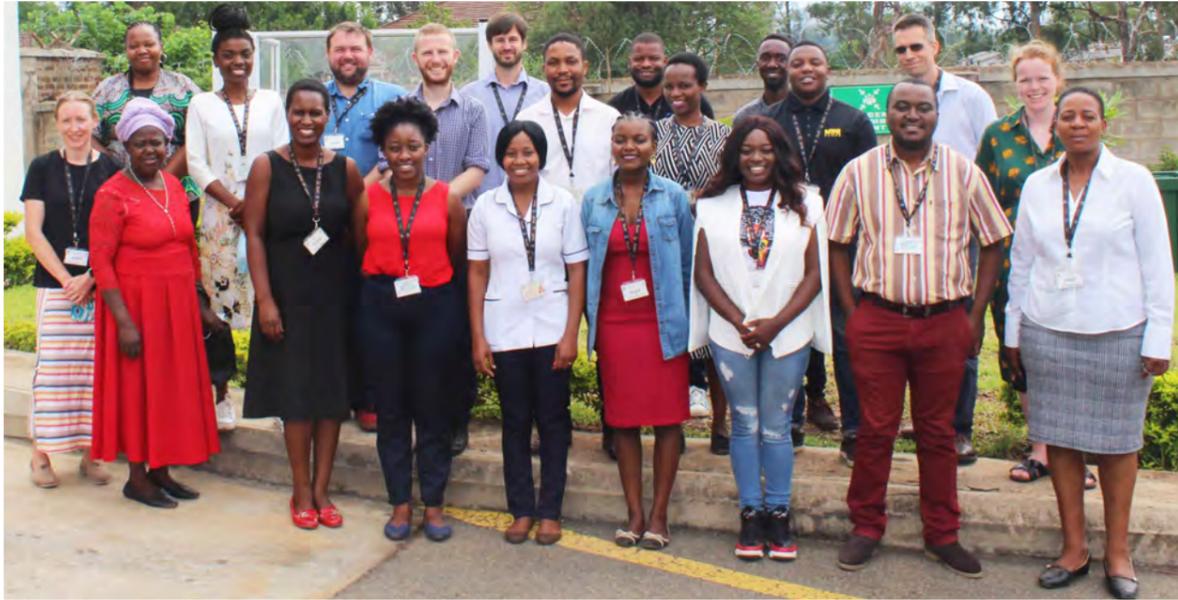


David Mzinza (left), Postdoctoral Research Associate, analysing samples using a flow cytometer in the laboratory at MLW. PhD fellow in Mucosal and Vascular Immunology Research Group Elizabeth Chimbayo processing peripheral blood samples in the laboratory at MLW. © MLW 2021. Photographer (both photos): Alick Chimzere, Creative works.

- **David Mhango**, PhD fellow, 'Transcriptome profiling of human alveolar macrophages to probe phenotypic heterogeneity and control of *Mycobacterium tuberculosis*', Supervisors: H Mwandumba/K Jambo/D Dockrell, Malawian, Active
- **Elizabeth Chimbayo**, PhD fellow, 'Diversity and dynamics of T cell receptor repertoire in HIV infected Malawian adults with pulmonary tuberculosis', Supervisors: H Mwandumba/J Brewer/P Garside, Malawian, Active
- **Leo Masamba**, PhD fellow, 'Association of HIV and DARC null with chemotherapy-induced febrile neutropenia', Supervisors: H Mwandumba/E Brown/A Muula, Malawian, Active
- **Aaron Chirambo**, PhD fellow, 'Polycytotoxic T lymphocytes in the human lung during latent tuberculosis infection and pulmonary tuberculosis disease', Supervisors: H Mwandumba/K Jambo/S Stenger, Malawian, Active
- **Steven Mitini-Nkhoma**, Pre-PhD Intern, 'Identification and characterisation of potential therapeutic targets to enhance alveolar macrophage control of *Mycobacterium tuberculosis*', Supervisors: H Mwandumba/A Shalek/G Biagini, Malawian, Active
- **Yohane Gadama**, MMed (Internal Medicine), Stellenbosch University, Malawian, Active
- **Cheusisime Kajanga**, MSc fellow, 'The impact of HIV-1 on the phenotype and function of *Mtb*-infected human alveolar macrophages', Supervisors: H Mwandumba/Y El-Sherbiny, Malawian, Active
- **Christine Mandalasi**, BEng. Biomedical Engineering student attachment, Supervisors: H Mwandumba/K Jambo, Malawian, Active
- **Evelyn Kossam**, Bachelor of Business Management and Entrepreneurship, Malawian, Active

VI. Future vision

- Strengthen the macrophage host-directed therapeutics programme.
- Invest in molecular biology and genomics expertise to diversity the Group's skillset and enhance productivity.
- Strengthen local and south-south multidisciplinary collaborations.
- Strengthen engagement with policymakers for public health impact.
- Liaise closely with MLW Training Committee to maintain an active pipeline of trainees.



Led by Prof. Nick Feasey (*back row, right*), the Bacterial and Drug Resistant Infection Group examine the causes of febrile illness in Malawi and how antibiotic resistant bacteria move between people, animals and the environment, and run a public engagement programme to make Malawians aware of antimicrobial resistance (AMR). © MLW. Photographer: Pauline Mlogeni.

Bacterial and Drug Resistant Infection

I. Overview

The Bacterial and Drug Resistant Infection Group (BDRI) investigates the causes of fever in adults and children in Malawi, from mild fevers not requiring antibiotics to life threatening ones. As antimicrobial resistance (AMR) makes bacterial infections more difficult to treat, we also actively investigate how antibiotic resistant bacteria move between people, animals and the environment and how to prevent transmission of these zoonotic diseases. Our work includes an expanding public engagement programme to make Malawians aware of AMR and its dangers and what they can do.

The Group is led by LSTM Prof Nick Feasey, the Chair of Wellcome's Surveillance and Epidemiology of Drug-Resistant Infections Consortium (SEDRIC) and Chair of the UK Department of Health Technical Advisory Group: The Fleming Fund. Nick is supported by Deputy Head Dr Samantha Lissauer, a Clinical Research Fellow with expertise in paediatric infectious diseases. Along with academic and clinical microbiologists, the Group team includes social scientists, molecular biologists, epidemiologists, parasitologists and infectious disease physicians.

The Group operates an environmental microbiology laboratory and uses culture and molecular techniques. The development of MLW's Laboratory Steering Committee and the roll out of sequencing capacity will be of strategic importance to the Group, enabling it to provide fine scale resolution of bacteria in our transmission studies.

The Bacteria and Drug Resistant Infection Group is currently engaged in activities in these areas:

I. The aetiology of febrile illness in urban and rural Malawi

- What is the aetiology of severe sepsis and febrile illness in urban and rural Malawi?
- What is the morbidity and mortality attributable to antibiotic resistant bloodstream infection in Blantyre?

II. Optimising the management of infectious disease in sub-Saharan Africa to minimise individual mortality and antimicrobial resistance in the community

- What is the impact, sustainability and acceptability of an antimicrobial stewardship programme at QECH?

III. How to interrupt the transmission of enteric pathogens and AMR bacteria

- Building a transmission model of Extended Spectrum Beta Lactamase (ESBL, a common cause of drug resistance), E. coli in Blantyre (Drivers of Resistance in Uganda and Malawi Consortium [DRUM])
- What is the ecological niche of E. coli in Blantyre and Chikwawa?
- What are the environmental reservoirs of S. Typhi?
- What impact does broad spectrum antimicrobial chemotherapy have on carriage of ESBL pathogens?

II. Scientific achievements 2021

The Bacteria and Drug Resistant Infection Group continues to be very productive, with numerous papers published in 2020-2021. Key results include:



A Bacterial and Drug Resistant Infection lab team member works with culture samples. © MLW. Photographer: Hendrina Nkuta.

Aetiology of febrile illness in Malawi

- Sepsis in Blantyre, Malawi, is caused by a range of pathogens, the majority of which are not susceptible to the broad-spectrum antibacterial agents that most patients receive.
- HIV status is a key determinant of aetiology.
- Novel antimicrobial strategies for sepsis tailored to sub-Saharan Africa – including consideration of empiric antitubercular therapy in the HIV-infected - should be developed and trialled.

How to interrupt the transmission of Salmonella Typhi

- Typhoid fever is typically associated with drinking water. In a large case control study, we high-

light diverse environmental exposures including use of river water for cleaning and social mixing patterns. (Clin Infect Dis 2020 Mar 17;70(7):1278-1284).

Antimicrobial stewardship in Malawi

- We report the successful introduction of an antimicrobial stewardship approach in Malawi.
- By focusing on pragmatic interventions and simple aims, we demonstrate the feasibility, acceptability and cost-saving of a stewardship program where resources are limited. In doing so, we provide a suitable starting point for expansion of AMS interventions in this and other low-income settings. (Clin Infect Dis 2020 Feb 15;ciaa162)

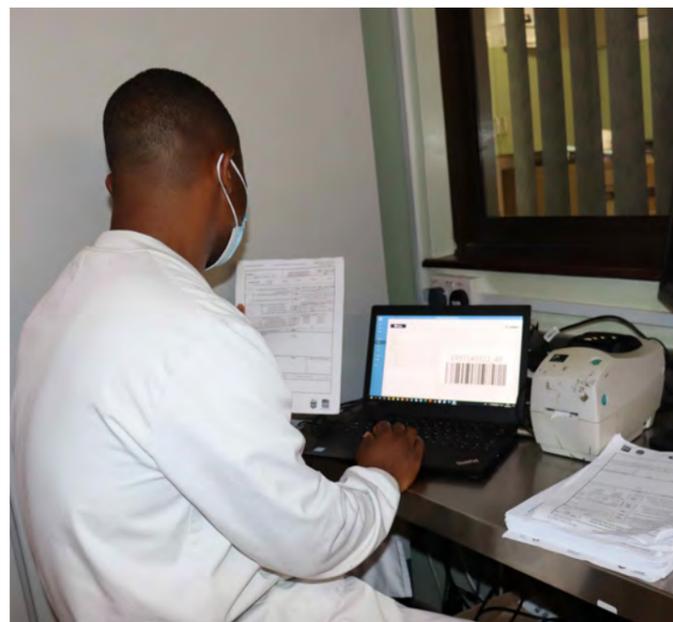
Public and policy engagement

- In 2019 the group hosted Wellcome's Public Engagement team and contribute to the writing of its AMR public engagement toolkit. This led to a 250,000 GBP award to develop AMR public engagement in Malawi set to begin end 2020 (Lead: Dr E. MacPherson)

- Research carried out by the Bacteria and Drug Resistant Infection Group has contributed to the Malawi Ministry of Health (MoH)'s AMR Technical Working Group (TWG). The Group has shared MLW data with MoH TB TWG to inform discussion around restrictions on amikacin use.
- National roll-out of environmental surveillance for SARS-CoV-2 is under active discussion with the Public Health Institute of Malawi (PHIM).

III. Top 5 publications since 2020

Members of the Bacteria and Drug Resistant Infection Group have published 5 papers in 2021, of which these are the 5 most significant (group member names in **bold**):



A BDRi Group Lab team member collates data.
© MLW. Photographer: Hendrina Nkuta.

1. Laboratory informatics capacity for effective antimicrobial resistance surveillance in resource-limited settings. Turner P, Rupali P, Opintan JA, Jaoko W, **Feasey NA**, Peacock SJ, Ashley EA. *Lancet Infect Dis*. 2021 Jun;21(6):e170-e174. doi: 10.1016/S1473-3099(20)30835-5. Epub 2021 Apr 15. PMID: 33865461.
2. Spatial and genomic data to characterize endemic typhoid transmission. Gauld JS, Olgemoeller F, Heinz E, Nkhata R, Bilima S, Wailan AM, Kennedy N, Mallewa J, Gordon MA, Read JM, Heyderman RS, Thomson NR, Diggle PJ, **Feasey NA**. *Clin Infect Dis*. 2021 Aug 31;ciab745. doi:10.1093/cid/ciab745. Online ahead of print. PMID: 34463736.
3. Genomic investigation of a suspected *Klebsiella pneumoniae* outbreak in a neonatal care unit in sub-Saharan Africa. Cornick J, Musicha P, Peno C, Seager E, Iroh Tam PY, Bilima S, Bennett A, Kennedy N, **Feasey N**, Heinz E, Cain AK. *Microb Genom*. 2021 Nov;7(11):000703. doi: 10.1099/mgen.0.000703. PMID: 34793293.
4. Optimized methods for detecting *Salmonella* Typhi in the environment using validated field sampling, culture and confirmatory molecular approaches. **Rigby J**, Elmerhebi E, **Diness Y**, **Mkwanda C**, **TontholaK**, Galloway H, Miles R, Henrion MYR, Edwards T, Gauld J, Msefula C, Johnston R, Nair S, **Feasey N**, Elviss NC. *J Appl Microbiol*. 2021 Jul 29. doi: 10.1111/jam.15237. Online ahead of print. PMID: 34324765.
5. A longitudinal observational study of aetiology and long-term outcomes of sepsis in Malawi revealing the key role of disseminated tuberculosis. **Lewis JM**, **Mphasa M**, Keyala L, **Banda R**, Smith EL, Duggan J, Brooks T, Catton M, Mallewa J, Katha G, Gordon SB, Faragher B, Gordon MA, Rylance J, **Feasey NA**. *Clin Infect Dis*. 2021 Aug 18;ciab710. doi: 10.1093/cid/ciab710. Online ahead of print. PMID:34407175.

IV. Translation

BDRi currently has these projects in the translational pathway:

- We lead on the development of Antimicrobial stewardship at Queen Elizabeth Central Hospital, which will be broadened through the ADILA consortium led by Mike Sharland at St. Georges

University London. We are moving into diagnostic stewardship in partnership with the ACORN Consortium, led by Paul Turner at COMRU (lead = Lissauer)

- Our work on environmental surveillance for SARS-CoV-2 has direct translational potential and we are discussing how to achieve this with PHIM.

V. Trainees in 2021

- **Jonathan Rigby**, PhD fellow, 'To develop and optimize methods for the detection and isolation of (i) *Salmonella* (ii) Typhi from the environment', Supervisor: N Feasey, British, active



Some members of the BDRi lab team. © MLW. Photographer: Hendrina Nkuta.

- **Oliver Pearce**, PhD student, 'Modelling transmission of multi-drug resistant *Klebsiella pneumoniae* amongst inpatient neonates, accounting for within-species diversity and bacterial quantity', Supervisor: N Feasey, British, Active
- **Derek Cocker**, PhD fellow, 'Study of WASH and Antimicrobial Resistance in Malawi (SWARM)', Supervisors: N Feasey/A Singer, British, active
- **Catherine Wilson**, PhD fellow, 'The epidemiology of *E. coli* and non-typhoidal *Salmonella* at a household level in Malawi', Supervisors: N Feasey/M Gordon/E Fèvre, British, active
- **Rachel Byrne**, PhD fellow, 'molecular diagnostics for the surveillance of emerging infectious diseases', Supervisors: N Feasey, British, active
- **Don Kalonga**, MSc, Biostatistics, Chancellor College, Supervisors: M Henrion/N Feasey, Malawian, active
- **Gabriel Bunduki**, MSc Health Sciences, Antimicrobial Stewardship and Pre-PhD Intern, supervisor: N Feasey, Congolese, active
- **Effita Masoamphambe**, MSc Health Sciences, Antimicrobial Stewardship and Pre-MSc Intern, Supervisor: N Feasey, Malawian, active
- **Pamela Kamanga**, BSc Public Health, Supervisor: N Feasey, Malawian; active
- **Yohane Diness**, MSc Medical Laboratory Sciences, Supervisor: N Feasey, Malawian, active
- **Kate Mangulama**, MBA with Project management, Sponsor: N Feasey, Malawian, active
- **Macwellings Phiri**, MPH, Supervisor: E MacPherson, Malawian, active
- **Diana Kululanga**, MSc Epidemiology, Supervisor: S Lissauer, Malawian, active

VI. Future vision

In 2021, Feasey was awarded a NIHR Global Health Professorship, which will permit the group to expand into the study of Infection Prevention and Control in Southern Malawi.



Salmonella and Enterics Research Group Lead Melita Gordon (back row, 2nd right) and her team members conduct research to understand and prevent typhoid fever and invasive Non-Typhoidal Salmonella (iNTS) disease, two invasive bacterial diseases with a devastating public health impact in Malawi and sub-Saharan Africa. © MLW. Photographer: Pauline Mlogeni.

Salmonella and Enterics

I. Overview

The Salmonella Group works to understand and prevent 2 forms of invasive Salmonella disease in Africa: Typhoid fever, caused by *Salmonella typhi*; and invasive Non-Typhoidal Salmonella (iNTS) disease, caused by *Salmonella typhimurium* and *Salmonella enteritidis*.

Typhoid accounts for over 3 million cases of febrile illness and 33,000+ deaths each year in sub-Saharan Africa, while invasive iNTS disease is annually responsible for over 77,000 deaths from 535,000 cases of serious illness – with the greatest burden falling on Africa and on very young children. Multidrug antimicrobial resistance (AMR) is an emerging problem for both these vaccine-preventable diseases.

Led by NIHR Research Professor Melita Gordon, supported by deputy Dr Tonney Nyirenda, and working with partners Dr Chisomo Msefula and Dr Ben Kumwenda in the Kamuzu University of Health Sciences, the Salmonella Group includes 2 postdoctoral researchers, 5 PhD students, 2 Masters students, 4 research interns, 5 laboratory technicians and approximately 30 nurses and fieldworkers. We work in the community, in the hospital and in the laboratory.

The Salmonella Group works to answer these key questions:

- 1) **Epidemiology:** how are invasive Salmonella diseases (typhoid and iNTS) transmitted and what is the disease burden?
- 2) **Host responses:** why are people susceptible, and how do their bodies generate immune protection?
- 3) **Pathogen:** What strains of the pathogen cause disease, are they drug-resistant, and how are they adapted?
- 4) **Vaccines:** how can we design, use and optimise vaccines to prevent Salmonella disease and make a positive impact on health?

To address these questions, the Group are engaged in several large projects, some as part of international consortia, in collaboration with longstanding international partners.

Epidemiology, to measure the burden and transmission of Salmonella diseases:

- Facility-based and community-based blood culture surveillance and incidence estimates (urban and rural);
- Community based sero-epidemiological surveys.

Host immunity, determining human protective immune responses to Salmonella infection:

- Systemic and gut mucosal immunity to typhoid and iNTS disease (PATCH-M study);
- Existing and new serological markers and correlates of natural protection (STRATAA & SAiNTS);
- Molecular detection studies in health and disease (SAiNTS);
- Systems serology, to understand functional protective mechanisms (OptiVaNTS study).



Salmonella and Enterics the TYVAC team celebrating 3-year typhoid conjugate vaccine efficacy results of 80%. © MLW. Photographer: Melita Gordon.

Bacteria, genetics of typhoid and iNTS-causing bacteria:

- Understanding the range of serovars circulating in health and disease (STRATAA study);
- Tracking the emergence and genomics of multidrug resistant (MDR) bacteria.

Vaccines, clinical trials from phase 2a through to 4:

- First clinical efficacy trial of a typhoid conjugate vaccine (TCV) in Africa (TyVAC);
- Immunogenicity of TCV;
- Phase 2a Immunogenicity and safety of a trivalent conjugate/GMMA vaccine for Typhoid and iNTS (Triple study);
- Cost of Illness and Cost Effectiveness estimates for typhoid and iNTS disease (TyVAC1);
- TCV impact studies before and after national introduction of TCV (TyVAC2).

II. Scientific achievements 2021

The Salmonella Group continues to be productive, with 12 papers published in 2021. Salmonella group's important recent results include:

Epidemiology

- Demonstration of very high incidence of typhoid, 444/100,000 PYO, in STRATAA study;
- Geolocation and phylogenomic modelling studies of typhoid;
- Study of community reservoirs of iNTS in human, animals and the household environment;
- Sero-epidemiological and seasonal study of iNTS across 4 Africa countries (VacciNTS and SAiNTS).

Host responses

- Gut cellular mucosal immunity in typhoid and NTS in adults and children;
- Systems serology collaboration with Alter lab (Harvard) to establish functional correlates of protection for children susceptible to iNTS disease (OptiVaNTS).

Bacteria

- Genomic description of emerging fluoroquinolone resistance in Malawi *S. typhi* strains;
- Genomic description of emerging iNTS strain with extended drug resistance;
- Community reservoirs and diversity of NTS in human, animals and the household environment, suggesting human reservoirs for iNTS.



Prof. Melita Gordon presents the Typhoid Vaccine efficacy results to the media in 2021. © MLW. Photographer: Zuze Matoliro.

Vaccines

- 18-month and 3-year results of first trial in Africa of a typhoid conjugate vaccine, showing good safety, excellent immunogenicity, and 81% vaccine efficacy across all ages.

Capacity building

- Building steering group for the Clinical Research and Training Open Resource (CREATOR) project;
- Establishing serology laboratory for iNTS/SAiNTS, in a regional partnership with Burkina Faso and Ghana;



Theresa Misiri being interviewed during the Typhoid Vaccine Study press briefing on the results of the TYVAC efficacy in 2021. © MLW. Photographer: Zuze Matoliro.

- Joint membership of the Global Typhoid Genomes Consortium (GTGC) (Msefula).

Community and Public Engagement

- Malawi newspaper articles, national radio interviews and phone-ins (Chichewa);
- Intern in social science studying community perceptions of typhoid and acceptability of typhoid vaccines;
- BBC radio interview and BBC TV interviews for “Bump-It-Forward” Covid-19 PPE campaign, supported by LSTM, raising £270K for hospital PPE;
- Extensive public and community engagement in Chikwawa for SAiNTS, including film made and screened.

III. Top 5 publications since 2020

These are the most important of the 12 papers published in 2021 by members of the Salmonella Group in scientific journals (related/group member names in **bold**):

1. Safety and Efficacy of a Typhoid Conjugate Vaccine in Malawian Children. **Patel PD, Patel P, Liang Y, Meiring JE, Misiri T, Mwakiseghile F, Tracy JK, Masesa C, Msuku H, Banda D, Mbewe M, Henrion M, Adetunji F, Simiyu K, Rotrosen E, Birkhold M, Nampota N, Nyirenda OM, Kotloff K, Gmeiner M, Dube Q, Kawalazira G, Laurens MB, Heyderman RS, Gordon MA*, Neuzil KM***; TyVAC Malawi Team. *N Engl J Med.* 2021 Sep 16;385(12):1104-1115. doi: 10.1056/NEJMoa2035916. PMID: 34525285.
2. Burden of enteric fever at three urban sites in Africa and Asia: a multicentre population-based study. **Meiring JE, Shakya M, Khanam F, Voysey M, Phillips MT, Tonks S, Thindwa D, Darton TC, Dongol S, Karkey A, Zaman K, Baker S, Dolecek C, Dunstan SJ, Dougan G, Holt KE, Heyderman RS, Qadri F, Pitzer VE, Basnyat B, Gordon MA, Clemens J, Pollard AJ**; STRATAA Study Group. *Lancet Glob Health.* 2021 Dec;9(12):e1688-e1696. doi: 10.1016/S2214-109X(21)00370-3. PMID: 34798028.
3. A clinical and molecular epidemiological survey of hepatitis C in Blantyre, Malawi, suggests a historic mechanism of transmission. **Stockdale AJ, Kreuels B, Shawa IT, Meiring JE, Thindwa D, Silungwe NM, Chetcuti K, Joeques E, Mbewe M, Mbale B, Patel P, Kachala R, Patel PD, Malewa J, Finch P, Davis C, Shah R, Tong L, da Silva Filipe A, Thomson EC, Geretti AM, Gordon MA.** *J Viral Hepat.* 2022 Jan 25. doi: 10.1111/jvh.13646. PMID: 35075742.
4. Hepatitis B vaccination impact and the unmet need for antiviral treatment in Blantyre, Malawi. **Stockdale AJ, Meiring JE, Shawa IT, Thindwa D, Silungwe NM, Mbewe M, Kachala R, Kreuels B, Patel P, Patel P, Henrion MYR, Bar-Zeev N, Swarthout TD, Heyderman RS, Gordon SB, Geretti AM, Gordon MA.** *J Infect Dis.* 2021 Nov 9;jjab562. doi: 10.1093/infdis/jjab562. PMID: 34752631.



5. A Bayesian approach for estimating typhoid fever incidence from large-scale facility-based passive surveillance data. Phillips MT, **Meiring JE**, Voysey M, Warren JL, Baker S, Basnyat B, Clemens JD, Dolecek C, Dunstan SJ, Dougan G, **Gordon MA, Thindwa D**, Heyderman RS, Holt KE, Qadri F, Pollard AJ, Pitzer VE; STRATAA Study Group. *Stat Med.* 2021 Nov 20;40 (26):5853-5870.doi: 10.1002/sim.9159. PMID: 34428309.

Salmonella PhD students Ndaru Jambo and Agness Lakudzala. © MLW. Photographer: Pauline Mlogeni.

IV. Translation

Our translational impact in 2021-21 includes:

- 18-month and 3-year vaccine efficacy trial data for Typhoid Conjugate Vaccines in Africa;
- Substantial contribution to Malawi’s new national viral hepatitis treatment policy;
- Writing group for a successful application to Gavi for National catch-up campaign and vaccine introduction of Typhoid Conjugate Vaccines from 2022.

In the longer-term, we anticipate these translational impacts of our work:

- Introduction and evaluation of the impacts of typhoid conjugate vaccines;
- Burden of iNTS disease in Malawi;
- Early phase clinical trials of iNTS vaccines;
- Correlates of protection for iNTS disease.

V. Trainees in 2021

- **Angeziwa Chirambo**, PhD fellow, ‘The role of gut microbiota in colonization resistance against common enteric pathogens in Malawian children’, Supervisors: M Gordon/T Nyirenda/A Kamng’ona/L Hall, Malawian, Active
- **Ndaru Jambo**, PhD fellow, ‘Characterisation of cellular and humoral responses induced by natural Salmonella infection’, Supervisors: M Gordon/T Nyirenda, Malawian, Active
- **Helen Dale**, PhD fellow, ‘Sero-correlates of protection for invasive non-typhoidal salmonella’, Supervisors: M Gordon/N French/T Nyirenda, British, Active
- **Esmelda Chirwa**, PhD fellow, ‘Are humoral immune responses to non-typhoidal Salmonella influenced by nutrition and gut health?’ Supervisors: M Gordon/ N French/T Nyirenda, Malawian, Active
- **Jessie Khaki**, ‘Spatiotemporal evidence synthesis for typhoidal and non-typhoidal Salmonella infection in Ndirande, Blantyre’, Malawi, Supervisors: E Giorgi/M Henrion/M Gordon, Malawian, Active
- **Priyanka Patel**, MSc Clinical Trials, Supervisor: M Gordon, Indian, Active
- **Hlulose Chafuwa**, Pre-MSc Intern, Supervisor: M Gordon, Malawian, Active

VI. Future vision

- A growing cohort of Malawian and International multidisciplinary clinical and laboratory scientists, leading work in Salmonella disease;
- Impact from national introduction of typhoid vaccines;
- Progress towards vaccination and impact for iNTS disease;
- Increased local capacity for Salmonella disease surveillance and evaluation using multiple methodologies and high throughput platforms.



Headed by Dr Khuzwayo Jere (back row, 4th right) and Deputy Head Prisca Benedicto-Matambo (first row, 2nd right), the Virology Group focusses on rotavirus infection and vaccination, and evaluates other important new viruses as they emerge in Malawi. © MLW. Photographer: Hendrina Nkuta.

Virology

I. Overview

The Virology Research Group's activities focus on understanding the epidemiology, immunology, evolution and disease burden of viral pathogens. With a long focus on the effectiveness of rotavirus vaccines, the Group also evaluates other important viruses from genetics to public health.

Led by Dr Khuzwayo Jere and Deputy Head Prisca Benedicto-Matambo, with administrative support from Evelyn Kossam, the Virology Research Group aim to determine:

1. The immune responses induced by rotavirus vaccination and rotavirus natural infection;
2. The immunological basis for the reduced rotavirus vaccine effectiveness in Malawian children;
3. The host factors associated with vaccine responses;
4. The impact of rotavirus vaccine on rotavirus strains; and
5. The immunogenicity and efficacy of new rotavirus vaccines in Malawian children.

More recently, the Virology Group, in collaboration with Kamuzu University of Health Sciences (KUHeS) and MLW's Genomic Epidemiology & Antimicrobial Resistant Microbes (GEARM) Group, established Malawi's first in-country sequencing capacity to help determine the origins and genetic epidemiology of SARS-CoV-2 circulating in Malawi. The Virology Group is expanding to understand other key enteric pathogens.

II. Scientific achievements 2021

Key findings from the Virology Group's 31 papers published in 2021 include work on:

Immunological basis for reduced rotavirus vaccine effectiveness in Malawian children

- Low plasma rotavirus-specific IgA is a risk for rotavirus vaccine failure in infants in Malawi (*Clin Infect Dis.* 2021).

- High maternal antibodies and the wide diversity of microbiota impairs the immunogenicity of oral rotavirus vaccine in African, Indian, and European infants (*Nat Commun.* 2021 Dec 15;12(1):7288).

Rotavirus strains circulating in Malawi

- Determined rotavirus strains circulating in Blantyre Malawi from 1997-2020 and evaluated the impact of Rotarix vaccine introduction on genotype distribution and rotavirus strain-specific effectiveness (*J. Infect Dis.* 2020 Oct 9. pii: 5919783).

Rotavirus vaccine impact

- The Group showed that continued use of rotavirus vaccine has led to the reduction in severity of all-cause gastroenteritis requiring hospitalisation in children vaccinated against rotavirus in Malawi. (*Viruses.* 2021 Dec 13;13(12):2491).
- The neonatal RV3-BB was well tolerated and immunogenic when co-administered with routine vaccines in a neonatal or infant schedule. A lower titre (mid-titre) vaccine generated similar IgA seroconversion to the high-titre vaccine presenting an opportunity to enhance manufacturing and reduce costs. (*Lancet Infect Dis.* 2022, doi.org/10.1016/S1473-3099(21)00473-4).

Origin and genetic epidemiology of SARS-CoV-2 circulating in Malawi:

- The Virology Group have shown the circulation of Alpha, Beta, Delta and recently Omicron SARS-CoV-2 variants in Malawi, most of which was due to importations. We have tracked viral genetics at the clinic, hospital and environmental level (manuscripts in preparation).

Engagement with policymakers

- Dr Jere was part of the special Malawi National Immunization Technical Advisory Group (MAITAG) group whose review led MAITAG to recommend the Salmonella Typhoid Conjugate Vaccine and COVID-19 vaccines.



The first child to receive the VP8*-P2 non-replication rotavirus vaccine in the NRRV clinical trial. ©MLW 2021. Photographer: Dr Edson Mwinjiwa.

- Dr Barnes has worked with the Public Health Institute of Malawi (PHIM) and the Malawi MoH to provide genomic and sequencing expertise and how environmental surveillance can be used country-wide for viral detection.
- Prisca Benedicto-Matambo participated in policy engagement and research uptake training by the African Institute for Development Policy (AFIDEP). She also engaged with MoH officials and with Dr Matthews Ngwale, Chair of the parliamentary committee on health, on strengthening collaboration between the committee and MLW.
- Group members were heavily involved in the PROTECT study, work that led to a clearer understanding of prevalence of SARS-COV-2 and that has also helped the Malawi MoH's public health programme.
- Dr Jere is co-founder of the African Enteric Viral Genome Initiative (AEVGI) and an active member of the African Rotavirus Network (ARS).

Public engagement

- The Group have actively engaged with local media, presenting study progress reports and science articles. Dr Jere and Dr Kamng'ona were on Malawi Broadcasting Corporation (MBC) TV's News Outlook and Health Talk programmes and regularly appeared on Umoyo N'kukambirana programmes on MBC Radio and Times Radio. Dr Kamng'ona and Dr Isaac Shawa appeared on Times Television to discuss COVID-19 detection and prevention in Malawi.

Top 5 publications since 2020 (Group member names in bold)

These are the most important of the 31 papers published in scientific journals in 2021 by the Virology Group (group member names in **bold**):



Diarrhoea Surveillance Nurse Orpha Kumwenda recruiting a participant into the study at Queen Elizabeth Central Hospital. ©MLW 2021. Photographer: Mphatso Mayuni.

1. Reduction in Severity of All-Cause Gastroenteritis Requiring Hospitalisation in Children Vaccinated against Rotavirus in Malawi. **Mandolo JJ**, Henrion MYR, **Mhango C**, **Chinyama E**, **Wachepa R**, **Kanjerwa O**, **Malamba-Banda C**, **Shawa IT**, Hungerford D, **Kamng'ona AW**, Iturriza-Gomara M, Cunliffe NA, **Jere KC**. *Viruses*. 2021 Dec 13;13(12):2491. [https://doi: 10.3390/v13122491](https://doi.org/10.3390/v13122491). PMID: 34960760.
2. Impact of maternal antibodies and microbiota development on the immunogenicity of oral rotavirus vaccine in African, Indian, and European infants. Parker EPK, Bronowski C, Sindhu KNC, Babji S, Benny B, Carmona-Vicente N, Chasweka N, **Chinyama E**, Cunliffe NA, Dube Q, Giri S, Grassly NC, Gunasekaran A, Howarth D, Immanuel S, **Jere KC**, Kampmann B, Lowe J, Mandolo J, Praharaj I, Rani BS, Silas S, Srinivasan VK, Turner M, Venugopal S, Verghese VP, Darby AC, Kang G, Iturriza-Gómara M. *Nat Commun*. 2021 Dec 15;12(1):7288. [https://doi: 10.1038/s41467-021-27074-1](https://doi.org/10.1038/s41467-021-27074-1). PMID: 34911947.
3. Plasma rotavirus-specific IgA and risk of rotavirus vaccine failure in infants in Malawi. Pollock L, Bennett A, **Jere KC**, **Mandolo J**, Dube Q, Bar-Zeev N, Heyderman RS, Cunliffe NA, Iturriza-Gomara M. *Clin Infect Dis*. 2021 Nov 12:ciab895. doi: [https://10.1093/cid/ciab895](https://doi.org/10.1093/cid/ciab895). PMID:34788820.
4. Distinct clinical and immunological profiles of patients with evidence of SARS-CoV-2 infection in sub-Saharan Africa. Morton B, **Barnes KG**, Anscombe C, **Jere K**, **Matambo P**, **Mandolo J**, Kamng'ona R, Brown C, Nyirenda J, Phiri T, Banda NP, Van Der Veer C, Mndolo KS, Mponda K, Rylance J, Phiri C, Mallewa J, Nyirenda M, Katha G, Kambiya P, Jafali J, Mwandumba HC, Gordon SB; Blantyre COVID-19 Consortium, Cornick J, Jambo KC. *Nat Commun*. 2021 Jun 11;12(1):3554. [https://doi: 10.1038/s41467-021-23267-w](https://doi.org/10.1038/s41467-021-23267-w). PMID:34117221.
5. Using genomics to improve preparedness and response of future epidemics or pandemics in Africa. Chaguzo C, Nyaga MM, Mwenda JM, Esona MD, **Jere KC**. *Lancet Microbe*. 2020 Nov;1(7):e275-e276. doi: [10.1016/S2666-5247\(20\)30169-5](https://doi.org/10.1016/S2666-5247(20)30169-5). PMID: 26507138.

IV. Translation

The Virology Group's direct global impact includes:

- Showing that RV1 reduces rotavirus-associated hospitalization cases and has reduced diarrhoea-related mortality by a third in Malawi. This is important for lobbying governments to source alternative funding for rotavirus vaccines as most low-income countries are now graduating from 5-year GAVI support;
- Testing two new alternative rotavirus vaccines in Malawian children: RV3-BB (MCRI) and a P2-VP8* subunit (PATH) vaccine. We found that the neonatal RV3-BB vaccine was well tolerated in both neonatal and infant schedule. A lower dose of RV3-BB vaccine generated similar immune response to a high dose, making rotavirus vaccination more affordable to resource-limited countries; and
- Mathematical modelling to show that rotavirus vaccine effectiveness could be improved by including a booster dose at 9 months of age.

V. Trainees

- **Chikondi Malamba-Banda**, PhD fellow, 'Understanding the immunological factors that contribute to the underperformance of rotavirus vaccine in Malawian vaccinated infants', Supervisors: K Jere/K Jambo/M Iturizza-Gomara, Malawian, Active
- **Prisca Benedicto-Matambo**, PhD fellow, 'Immune Imprinting Effect of Neonatal Live Rotavirus Vaccination', Supervisors: K Jere/M Iturizza-Gomara/K Flanagan, Malawian, Active
- **Chimwemwe Mhango**, MSc fellow, 'Multiple independent seeding of typical human G3 rotaviruses on a Wa-like and DS-1-like genetic backbone in Blantyre Malawi', Supervisors: K Jere/A Kamng'ona, Malawian, Active
- **Akuzike Banda**, MSc fellow, 'Role of Evolutionary Mechanisms on The Emergence of Novel Rotavirus Strains', Supervisors: K Jere/A, Kamng'ona, Malawian, Active

VI. Future vision

Looking forward, the Virology Group aims to:

- Conduct serosurveys of enteric pathogens in Malawi;
- Establish the incidence of shigella bacteria to inform future vaccine trials;
- Sequence the common enteric pathogens associated with diarrhoea diseases;
- Establish a standardised lineage classification system for enteric viruses;
- Expand single cell capacity to inform immune response to vaccines; and
- Establish diarrhoea surveillance activities in Kenya and Ethiopia (Global Health programme).



Chimwemwe Mhango running gel electrophoresis used for genotyping rotavirus strains. ©MLW 2021. Photographer: Pauline Mlogeni.



Group lead David Lissauer (back row, 3rd left) and the Maternal and Fetal Health team contribute to improving maternal health outcomes in low-resource settings through clinical trials, implementation research and contributing to policy making. © MLW. Photographer: Hendrina Nkuta.

Maternal and Fetal Health

I. Overview

The Maternal and Fetal Health Group at MLW is focused on clinical and laboratory research that will improve the health and wellbeing of mothers and their babies. Our work includes clinical trials, improvement and behavioural science and laboratory work, with a particular focus on improving the detection, management and outcomes of serious infections during pregnancy and childbirth. The group also leads the DIPLOMATIC NIHR global health research group, which focuses on improving the quality of maternal care.

Led by NIHR Global Health Research Professor David Lissauer, the Group seeks to contribute to improving maternal health outcomes in low-resource settings through clinical trials, implementation research and a contribution to policy making. The Group is supported by Deputy Group Heads Dr Luis Gadama (clinical science lead), Dr Charlotte Van Der Veer (laboratory science lead), and Dr Moses Kumwenda (behavioural science lead).

The Maternal and Fetal Health Group work closely with colleagues in the Department of Obstetrics and Gynaecology and Paediatrics at Kamuzu University of Health Sciences (KUHeS), as well as the MoH Reproductive Health Directorate and Quality Management Directorate alongside multiple international collaborators.

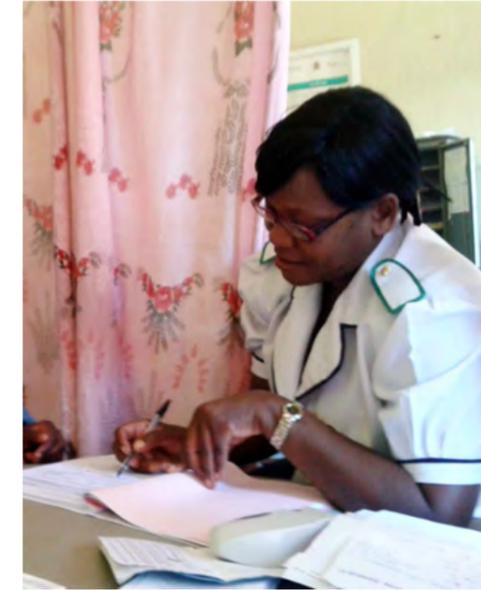
The Maternal and Fetal Health Group's work focuses on these key areas of activity:

The epidemiology of maternal and neonatal infection and immunity and related morbidity in Malawi, including the effects of COVID-19:

- matSURVEY project, which is operating across 31 hospitals in Malawi and providing real-time data for local and national policy makers on maternal health outcomes, quality of care and COVID-19;
- Work to understand the microbiology of maternal infections and anti-microbial resistance patterns in the maternal population;
- Understand the development of trained immunity in early life;
- Liaising with the microbiology department at KUHeS to provide microbiological diagnostics for maternity in Queen Elizabeth Central Hospital.

Preventing maternal infections in health care facilities:

- WHO Maternal Infection Prevention Project, developing maternal health specific hand hygiene tools;



It is important that pregnant women are included in recruitment to clinical trials © MLW. Photographer: David Lissauer.

- Evaluating a complex intervention to determine the clinical and cost effectiveness of APT-Sepsis, the Active Prevention and treatment of maternal sepsis programme.

Improving management and care of maternal and neonatal infections and sepsis in Malawi:

- Developing the FAST-M+ bundle programme;
- Field test the new WHO labour care guide;
- Understanding how lactate testing can be used to improve maternal sepsis identification: a multi-country test accuracy study and feasibility assessment.

Improving the quality of maternal care:

- The DIPLOMATIC NIHR Global Research Group, improving the quality of antenatal care to reduce pre-term birth and still birth.

Developing maternal and fetal health researchers able to lead research projects important for health in Malawi:

- The Group have appointed 3 new PhD students, 2 tenure track fellows and a post-doctoral research fellow. Another post-doctoral researcher will be appointed soon.

II. Scientific achievements 2021

The Maternal and Fetal Health Group continue to be very productive, with key results achieved in:

The epidemiology of maternal infection and related morbidity in Malawi, including the effects of COVID-19

- The Malawi MoH and District Health Management teams now have access to maternal mortality, maternal near-miss and maternal COVID-19 real time data from every district and central hospital in Malawi via online dashboards. These provide maternal and neonatal health outcomes, COVID-19 cases and their outcomes, quality of care data and service utilisation data. This system has also digitised all maternal death reporting and reviews nationally.

Preventing maternal infections in Malawi

- The Group have completed work with the WHO on 3 modules to support infection prevention and control training specific to maternity settings. (<https://openwho.org/courses/care-pregnant-woman-antenatal-clinic-en>) Field testing this training material with practitioners in Malawi is underway.

Improving management and care of maternal and neonatal infections and sepsis in Malawi

- The Group have completed multi-site field testing and mixed-methods evaluation of the FAST-M+ intervention, which explored the feasibility of adding point-of-care Lactate testing, pulse oximetry and new implementation approaches to the existing intervention.

Engagement with policymakers

- Luis Gadama and David Lissauer are members of safe-motherhood TWG;
- The Group reports to the national Maternal Death Surveillance and Response Committee using data from the Maternal Surveillance platform;
- The Group regularly meets with the Quality Management Directorate and Reproductive Health Directorate teams at the Ministry of Health;

- Produced a weekly COVID 19 in pregnancy webinar series;
- In-person meetings with district management teams to provide feedback on maternal health data from their districts and discuss research activities.

Public Engagement

- Moses Kumwenda interviewed on radio about COVID-19. Series of radio shows on maternal health delivered by the team;
- COVID-19 surveillance study is providing real time data for use in hospitals nationwide via the MoH;
- Established a specific maternal and neonatal health public research engagement group;



Working with health care providers to understand how to improve the quality of maternity care.

© MLW. Photographer: David Lissauer.

- Trained the public research engagement group, including training for lay representatives on current trial steering committees.

III. Top 5 publications since 2020

These are papers highlighting the breadth and impact of the Groups work published in scientific journals in 2021 (group member names in **bold**):

1. Feasibility and acceptability of a peer-led HIV self-testing model among female sex workers in Malawi: a qualitative study. **Kumwenda MK**, Mavhu W, Lora WS, Chilongosi R, Sikwese S, Taegtmeier M, Hatzold K, Johnson CC, Corbett EL, Desmond N. *BMJ Open*. 2021, 11(12):e049248. doi: 10.1136/bmjopen-2021-049248.
2. Exploring the evolution of policies for universal antiretroviral therapy and their implementation across three sub-Saharan African countries: Findings from the SHAPE study. **Kumwenda M**, Skovdal M, Wringe A, Kalua T, Kweka H, Songo J, et al. *Glob Public Health*. 2021 Feb;16(2): 227–240. doi: 10.1080/17441692.2020.1851386. PMID: 33275872.
3. The FAST-M complex intervention for the detection and management of maternal sepsis in low-resource settings: a multi-site evaluation. **Cheshire J**, Jones L, **Munthali L**, Kamphinga C, Liyaya H, Phiri T, Parry-Smith W, **Dunlop C**, **Makwenda C**, Devall AJ, Tobias A, Nambiar B, Merriel A, Williams HM, Gallos I, Wilson A, Coomarasamy A, **Lissauer D**. *BJOG*. 2021 Jul;128(8):1324-1333. doi: 10.1111/1471-0528.16658. PMID: 33539610.
4. Availability of facility resources and services and infection-related maternal outcomes in the WHO Global Maternal Sepsis Study: a cross-sectional study. **WHO GLOSS Research Group**. *Lancet Glob Health*. 2021 Sep;9(9):e1252-e1261. doi: 10.1016/S2214-109X(21)00248-5. PMID: 34273300.
5. Educating surgical site infections in low-income and middle-income countries (FALCON): a pragmatic, multicentre, stratified, randomised controlled trial. **NIHR Global Research Health Unit on Global Sugery**. *Lancet*. 2021 Nov 6;398(10312):1687-1699. doi: 10.1016/S0140-6736(21)01548-8. PMID: 34710362.

IV. Translation

The Maternal and Fetal Health Group's work to translating science into public benefit since 2021 includes these contributions:

WHO Infection prevention training for maternity settings (<https://openwho.org/courses/care-pregnant-woman-antenatal-clinic-en>);

- The FAST-M toolkit (accompanying films also now produced) to improve management of maternal sepsis;
- Royal College of Obstetricians and Gynaecologists, Green top guidelines on maternal sepsis;
- Supported implementation of Malawi national COVID-19 surveillance programme;

- Provided technical and financial support to enable digitization of Malawi's maternal death reporting systems.



Designing and evaluating complex interventions that are feasible and sustainable. © MLW. Photographer: David Lissauer.

V. Trainees in 2021

- **Chikondi Chapuma**, PhD fellow, 'Understanding maternal infections and their impact on health outcomes in Malawi', Supervisors: Lissauer/Kumwenda, Malawian, Active
- **Yamikani Mbilizi**, PhD fellow, 'Knowledge and clinical utility of biomarkers of infection in pregnant and postpartum women', Supervisors: Lissauer/Odland, Malawian, Active
- **Jenny Riches**, PhD fellow, 'Prevention of Infection Related to Caesarean Section in Resource-Constrained Setting', Supervisors: Lissauer/Merriel, British, Active
- **Doreen Sakala**, PhD fellow, 'Investigating the role of social media as a form of social capital among sex workers in Malawi', Supervisors: Desmond/Kumwenda, Malawian, Active
- **Mtitsunge Gondwe**, PhD fellow, 'Evaluating the processes and outcomes of Stillbirth and Neonatal Death Audit as a quality improvement tool in the Southern Region of Malawi' Supervisors: Desmond/Allen/Aminu, Malawian; Active
- **Jennifer Trainor**, PhD fellow, 'The Meaning of Preterm Birth for Postnatal Mothers in Mpemba, Malawi', Supervisor: Desmond, British, Active
- **Sepedeeh Saleh**, PhD fellow, 'Air pollution in Mpemba, Malawi: A multidisciplinary exploration of the burden and possible solutions', Supervisors: Mortimer/Rylance/Chinouya/Kumwenda, British, Active
- **Laura Munthali**, MSc fellow, 'A Comparison between maternity cases admitted in critical condition to those in a stable condition with maternal mortality as an adverse outcome at Queen Elizabeth Central Hospital', Supervisor: Lissauer, Malawian, Active
- **Carolyn Gondwe**, MSc fellow, 'Hand hygiene practices amongst healthcare workers during the Covid-19 era at Livingstone Central Hospital, Zambia', Supervisor: Kumwenda, Malawian, Active
- **Leonard Mndala**, Pre-PhD intern, WHO IPC project, Supervisor: Lissauer, Malawian, Active
- **Fatima Mtonga**, 'DIPLO_STI: Pre-MSc intern, Supervisor: Van der Veer, Malawian, Active
- **George Shaba**, 'DIPLO_STI: Pre-MSc intern, Supervisor: Van der Veer, Malawian, Active

VI. Future vision

- Develop a team of new maternal health research leaders and support them to research independence;
- Contribution to improved maternal and neonatal health in Malawi and other low-income countries by delivering an ambitious programme of clinical trials, health systems and laboratory research.

Work with WHO and national stakeholders to support the development and implementation of evidence-informed policies to improve the quality of maternal and neonatal care in Malawi and other low-income countries.



With a strong emphasis on leading infectious disease killers HIV and TB, Public Health Lead Peter MacPherson (*back row, 2nd left*) and his team develop and evaluate targeted public health interventions that benefit patients in Malawi and sub-Saharan Africa and are effective, efficient and cost-effective for health care systems. © MLW. Photographer: Pauline Mlogeni.

Public Health

I. Overview

The Public Health Group address Malawi and sub-Saharan Africa's major public health challenges, with a strong emphasis on HIV and tuberculosis (TB), still among the world's leading infectious killers. The Group conduct research with people with undiagnosed disease or at risk of infection, people attending health facilities with symptoms of disease, and people being treated for diseases, particularly HIV and TB.

The Public Health Group apply its expertise in epidemiology, randomised trials, qualitative research, genomics, health economics, policy research, and mathematical modelling to develop and evaluate targeted public health interventions that identify those who will most benefit from them, and that will be effective, efficient and cost-effective for health systems.

The Public Health Group are led by Dr Peter MacPherson, supported by Deputies Dr Augustine Choko, Dr Marriott Nliwasa, Dr Rachael Burke and Dr Titus Divala, with Thandie Gondwe providing Admin support and Luke Banda providing Project Management support.

The Group have a strong student and trainee pipeline, with excellent Post-Doctoral, PhD and Masters trainees securing fellowships and producing outstanding scientific contributions.

The Public Health Group's current activities focus on:

Improving case detection in communities

- Use epidemiology, surveillance, genomics and modelling to identify areas and communities with poor access to care and high undiagnosed disease transmission for targeted public health interventions;

- Employ innovative epidemiological, statistical and randomised clinical trial (RCT) methods to evaluate interventions to mitigate risk factors, improve disease control and provide high-quality evidence to national, regional and global policymakers.

Reducing mortality in health facilities

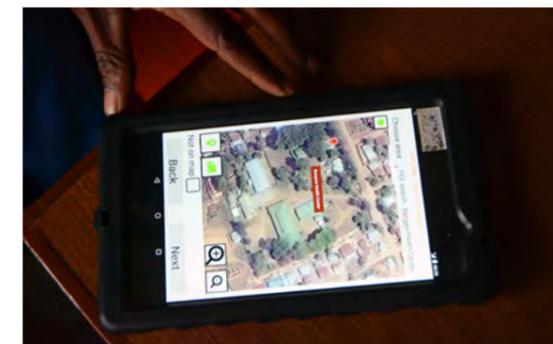
- Use screening for undiagnosed priority diseases to maximize health benefits and sustainability and minimise harms and costs;
- Design and rigorously evaluate the effectiveness and cost-effectiveness of TB/HIV screening and diagnostic interventions in healthcare settings to increase the yield of diagnosis, reduce the time to treatment, and improve mortality.

Optimising treatment and retention in care

- Working to better understand what drives suboptimal adherence and retention in care and develop and evaluate novel interventions that improve treatment outcomes and reduce adverse health consequences.

Looking forward, the Group sees strategic benefits arising from:

- The new Population Health Theme, as it will develop early career researchers, and foster cross-disciplinary innovation across MLW; and
- Integrated MLW data platforms linked to TB genomic data for high-resolution surveillance and epidemiology.



Fingerprint technology used during systematic TB screening for people attending Bangwe Health Centre in Blantyre. © MLW.

II. Scientific achievements 2021

The Public Health Group continue to be very productive, with 110 papers published in 2021. Key results include:

- Publication of the PROSPECT Trial results (MacPherson et al, *PLOS Medicine* 2021), showing that computer-aided diagnosis of TB on chest x-ray substantially and significantly increased rapid diagnosis in primary care. Malawi has started scaling up TB screening with computer-aided TB screening, and Dr MacPherson has been appointed to an expert WHO panel to evaluate computer-aided diagnosis software;
- Securing funding for major randomised trials (SADAPT Trial: same day vs. early antiretroviral therapy for adults with HIV) and South-le Consortia (e.g. Unitaid New tools for TB diagnosis);
- Having a major impact on global TB and HIV policy and guidelines, by contributing five systematic reviews and meta-analyses to the 2021 WHO Global HIV and TB Guidelines;
- Holding Public Health Group strategic planning away days and research culture café to articulate our vision for working collaboratively.

COVID-19

- Group members featured prominently in Malawi and international TV, radio and print news, including on BBC News; participated in community and church events; and delivered Facebook and other social media events as part of efforts to successfully advocate for important national public health responses to COVID-19, including: adoption of "cough mask in public" recommendations; international border screening regulations; school opening policy; contact tracing and isolation policy; community shielding of vulnerable groups.
- Membership in the Malawi Ministry of Health Expert advisory group on COVID-19, and the COVID-19 National Surveillance subcommittee of the Public Health Institute of Malawi.
- Member of the College of Medicine COVID-19 committee that advises Blantyre District Health Office, Queen Elizabeth Central Hospital, and Blantyre City Council.
- Provided expert scientific advice on COVID-19 to the University of Malawi council.

Public Engagement

- Promoted the PROSPECT study on national radio and print media.
- ACTS-TB study received media coverage, discussing the implications of novel TB diagnostic approaches (particularly computer-aided X-ray TB diagnosis).

III. Top 5 publications since 2020

These are the most important of the 110 papers published in scientific journals in 2021 by the Public Health Group (group member names in **bold**):

1. Community-based active case-finding interventions for tuberculosis: a systematic review. **Burke RM, Nliwasa M**, Feasey HRA, Chaisson LH, Golub JE, Naufal F, Shapiro AE, Ruperez M, Telisinghe L, Ayles H, Corbett EL, **MacPherson P**. *Lancet Public Health*. 2021 May;6(5):e283-e299. doi:10.1016/S2468-2667(21)00033-5. PMID: 33765456.
2. Partner-delivered HIV self-test kits with and without financial incentives in antenatal care and index patients with HIV in Malawi: a three-arm, cluster-randomised controlled trial. **Choko AT**, Fielding K, Johnson CC, Kumwenda MK, Chilongosi R, Baggaley RC, Nyirenda R, Sande LA, Desmond N, Hatzold K, Neuman M, Corbett EL. *Lancet Glob Health*. 2021 Jul; 9(7):e977-e988. doi: 10.1016/S2214-109X(21)00175-3. PMID: 34143996.
3. Virological failure, HIV-1 drug resistance, and early mortality in adults admitted to hospital in Malawi: an observational cohort study. Gupta-Wright A, Fielding K, van Oosterhout JJ, Alufandika M, Grint DJ, Chimbayo E, Heaney J, Byott M, Nastouli E, Mwandumba HC, Corbett EL, Gupta RK. *Lancet HIV*. 2020 Sept;7(9):e620-e628. PMID: 32890497.
4. Effects of Coronavirus Disease Pandemic on Tuberculosis Notifications, Malawi. Nwaza Soko R, **Burke RM**, Feasey HRA, Sibanda W, **Nliwasa M**, Henrion MYR, Khundi M, Dodd PJ, Ku C-C, Kawalazira G, **Choko AT**, **Divala TH**, Corbett EL, **MacPherson P**. *Emerg Infect Dis*. 2021 Jul;27(7):1831-1837. doi: 10.3201/eid2707.210557. PMID: 34152962.
5. Computer-aided X-ray screening for tuberculosis and HIV testing among adults with cough in Malawi (the PROSPECT study): A randomised trial and cost-effectiveness analysis. **MacPherson P**, Webb EL, Kamchedzera W, Joeke E, Mjoli G, Laloo DG, **Divala TH**, **Choko AT**, **Burke RM**, Maheswaran H, Pai M, Squire SB, **Nliwasa M**, Corbett EL (2021) *PLoS Med*. 2021 Sept 9;18(9):e1003752. <https://doi.org/10.1371/journal.pmed.1003752>. PMID: 34499665.

IV. Translation

The Public Health Group's contributions to translating science into a public health benefit include:

- Developing the eElectronic Participant Locator (ePAL) app, a GPS-based system that allows precise, remote geolocation of peoples' households. Widely adopted by MLW research groups, ePAL has been used in other international research settings.

V. Trainees in 2021

- **Leticia Suwedi**, PhD fellow, 'Enhanced Health Systems to improve uptake of early infant diagnosis among post-partum women in primary health care in Malawi', Supervisors: N Desmond/A Obasi/P MacPherson, Malawian, Active



Dr Peter MacPherson demonstrates a health diagnostic intervention developed by the Public Health Group. © MLW. Photographer: Peter MacPherson.

- **Linda Sande**, PhD fellow, 'Impact of HIV self-testing on costs, uptake and equity in HIV testing in Malawi', Supervisors: E Corbett/F Terris-Prestholt, Malawian, Active

- **Mphatso Phiri**, PhD fellow, 'Modelling interventions to improve engagement of young adults and men in tuberculosis active case finding in high HIV prevalence settings', Supervisors: P MacPherson/M Henrion/K Horton, Malawian, Active

- **Lucky Ngwira**, PhD fellow, 'Childhood health-related quality of life in context of economic evaluation in Malawi', Supervisors: E Corbett/H Maheswaran/S Petrou, Malawian, Active
- **Helena Feasey**, PhD fellow, 'TB-FACT: TB Testing Behaviour in Facilities and how it is Affected by Case finding Trials/interventions', Supervisors: E Corbett/H Burchett, British, Active
- **Hannah Rickman**, PhD fellow, 'Spatial heterogeneity of tuberculosis in Blantyre, Malawi: approaches to defining high-risk areas for targeted intervention', Supervisors: P MacPherson/E Corbett, British, Active
- **Alex Schade**, PhD fellow, 'Epidemiology of fractures and their treatment in Malawi: Results of a multicentre prospective registry study to guide orthopaedic care planning', Supervisors: P MacPherson/J Harrison/D Laloo, British, Active
- **Rachael Burke**, PhD fellow, 'Computer Aided Screening in Low Resource Settings', Supervisors: P MacPherson/E Corbett/A Gupta-Wright, British, Active
- **McEwen Khundi**, PhD fellow, 'Understanding factors affecting the effectiveness of TB interventions: A spatial analysis of patient notification and prevalence survey data from urban Blantyre, Malawi', Supervisors: P MacPherson/E Corbett/J Carpenter, Malawian, Active
- **Nick Riches**, PhD fellow, 'Chronic Liver Disease in Malawi: a community-based epidemiological study', Supervisors: P MacPherson/A Crampin/A Stockdale, British, Active
- **Rebecca Nwaza Soko**, 'Impact of COVID-19 restrictions on TB case notifications in urban Blantyre, Malawi', Supervisor: E Corbett, Malawian, Active
- **Jonny Miller**, MSc Global Health, 'Investigating risk factors for prevalent active TB disease among household contacts in South Africa (nested Case Control Study)', Supervisors: P MacPherson/M Henrion, Liberian, Active
- **Naomi Carter**, MSc Global Health, 'Prevalence of subclinical tuberculosis and its association with HIV in household contacts of tuberculosis in two South African provinces', Supervisors: P MacPherson, British, Active
- **Andrew Moseray**, MPH, 'Utilisation of health care services during tuberculosis care-seeking in Malawi: a cohort study', Supervisor: P MacPherson, British, Active
- **Bilal Wilson**, MPH, 'Comparison of six- and twelve-month attrition rates, before and after implementation of Universal HIV test and treat policy in Malawi', Supervisor: P MacPherson, Malawian, Active
- **Chikondi Kandulu**, MSc, Supervisor: T Divala, Malawian, Active
- **Wezzie Kamanga**, Pre-MSc Intern, 'Effectiveness of peer-led life skills education for HIV prevention among school-going youth in Mangochi district', Supervisors: N Desmond/P MacPherson, Malawian, Active

VI. Future vision

- Expansion of fine-resolution surveillance for HIV and TB epidemiology to accelerate progression towards elimination.
- Expansion in TB/HIV diagnostic evaluations and randomised trials; leading global-consortia.
- Progression of postdoctoral students to independent researchers.



Members of the Neglected Tropical Diseases' TrypanoGen team conduct Trypanosomiasis active surveillance in Rumphu. © MLW. Photographer: Peter Nambala.

Neglected Tropical Diseases

I. Overview

The Neglected Tropical Diseases Group investigate host/parasite interactions and transmission dynamics, climate impact on neglected tropical diseases (NTDs), mostly Human African Trypanosomiasis (HAT, or sleeping sickness), and schistosomiasis (also known as bilharzia), and map the geographical locations of these diseases. The group collaborate with other researchers working on other NTDs such as onchocerciasis, lymphatic filariasis, soil transmitted helminths and teianiasis. Trypanosomiasis and schistosomiasis have a devastating impact on health in Africa.



Associate Professor Janelisa Musaya leads the Neglected Tropical Diseases Group. © MLW. Photographer: Pauline Mlogeni.

In Malawi, HAT is caused by *Trypanosoma brucei rhodesiense* parasites transmitted by tsetse flies. HAT transmission requires the interaction of humans, tsetse flies and human or animal parasite reservoirs. In Malawi, 0.9 million people are at risk of HAT, the highest in the southern part of the rhodesiense distribution. Sleeping sickness mostly affects poor rural populations, causing significant harm.

Similarly, schistosomiasis is a disease of the poor. Caused by parasitic worms, schistosomiasis is second only to malaria in its devastating impact. Infection occurs when skin comes in contact with contaminated freshwater that contains cercariae shed by snails that carry schistosomes. In Malawi, the impact of schistosomiasis is considerable, with over 40% of the population at risk of the infection, and emergence of hybrid schistosomiasis is evident.

Associate Professor Janelisa Musaya and Deputy Group Heads Seke Kayuni and Peter Nambala lead a 13-member team of medical parasitologists, molecular chemists, environmentalists, epidemiologists, laboratory technologists, vector biologists and veterinarians. The Group fill important gaps in the understanding of trypanosomiasis and schistosomiasis, strengthening Malawi's disease control infrastructure while promoting one health and developing the next generation of African scientists.

The Neglected Tropical Disease Group is focused on answering critical research questions in these areas of significant importance to Malawians' well-being:

Determine transmission dynamics of trypanosomiasis and schistosomiasis in Malawi

- Assess the prevalence of hybrid schistosomes along Lake Malawi, including male genital schistosomiasis (MGS) and female genital schistosomiasis (FGS) (S. Kayuni, R. Stothard, J. Musaya, P. Makaula - Schisto hybrid study);



Neglected Tropical Diseases team examine snails for schistosomiasis. © MLW. Photographer: Alexandra Juhász.

- Determine the prevalence of trypanosomiasis in Rumphu and Nkhota-kota districts (P. Nambala, J. Musaya, E. Matove, E. Senga - TrypanoGen plus study).

Ascertain if mapping trypanosome and schistosome areas is necessary for transmission interventions

- Geomap trypanosomiasis in Rumphu and Nkhota-kota (J. Musaya, S. Mphande - MapTryp study);
- Map the aetiology of schist somiasis along Lake Malawi (S. Kayuni, J. Musaya, R. Stothard - Hugs study).

Discover the causes of susceptibility to trypanosomiasis in humans

- Identify the genetic determinants of susceptibility and tolerance (asymptomatic) to HAT (K. Kamoto, J. Musaya, P. Chamudzi, J. Chisi - TrypanoGen one study);
- Investigate the role of the parasite in the determination of these HAT phenotypes and identify the interplay between the parasite and host genetics (P. Nambala, J. Musaya, E. Senga, P. Chamudzi - TrypanoGen plus study);
- Characterise the molecular structure of human and tsetse fly derived trypanosomes (future work);
- Cytokine profiling of *Trypanosoma* susceptible individuals with early and late-stage disease (K. Kamoto, J. Musaya, J. Chisi - TrypanoGen one study);
- Determine the disease profile of Malawian trypanosomes in mice (P. Nambala, J. Musaya - TrypanoGen plus study).

Audit the effectiveness of schistosomiasis control measures

- Assess community directed mass drug administration (MDA) and compare with current MDA system (P. Makaula, J. Musaya, S. Kayuni, K. Mamba, L. Juziwelo, P. Furu - SCHIMDA study).

Identify area specific communication strategy

- Assess the effectiveness of using street science as communication system for trypanosomiasis in a malaria endemic area (J. Musaya, A. Macleod, Walt Adamson - Scopten study).

Develop effective antimicrobial stewardship strategies for Malawi

- Determine antimicrobial stewardship strategies and measures for Malawi.

II. Scientific achievements 2021

The Neglected Tropical Diseases Group continues to be productive, with 5 papers published in 2021. Key results include:



Neglected Tropical Diseases Deputy Group Head Dr Seke Kayuni explaining to school age participants how to use urine and stool bottles in Nsanje. © MLW. Photographer: Alexandra Juhász.

Ascertain if mapping trypanosome and schistosome areas is necessary for transmission interventions

- Geospatial mapping of trypanosomiasis cases;
- Area-specific targeted interventions that are acceptable to affected communities for sustainable prevention and control.

Discover the causes of susceptibility to trypanosomiasis in humans

Plasma cytokine quantification among *Trypanosoma brucei rhodesiense* sleeping sickness cases and controls in Rumphi, Malawi. *Malawi Medical Journal*. 2021;33. 230-235. 10.4314/mmj.v33i4.2.

Audit the effectiveness of schistosomiasis control measures

- Using community directed intervention in MDA might be beneficial as a national strategy, (Work in progress)

Identify novel diagnostic tools for trypanosomiasis

- Development of a bio-inkjet printed LAMP test kit for detecting HAT (*PLoS Negl Trop Dis*. 2020;14(10): e0008753)
- Use of nanopore in detecting trypanosomiasis, a method towards AAT control (*Parasite* 2020;27(1):46).

Develop effective antimicrobial stewardship strategies for Malawi

- Supporting various student AMR projects (ongoing).

III. Top publications in 2021

These are the most important of the 5 papers published in scientific journals in 2021 by the Neglected Tropical Diseases Group (group member names in **bold**):

1. Plasma cytokines quantification among *Trypanosoma brucei rhodesiense* sleeping sickness cases and controls in Rumphi, Malawi. **Kamoto K, Chiyawa A, Nambala P, Chammudzi P, Senga E, Chisi J, Matovu E, Musaya J.** *Malawi Medical Journal*.2021; 33:230-235. 10.4314/mmj.v33i4.2.
2. Healthcare-associated infections and antimicrobial use in surgical wards of a large urban central hospital in Blantyre, Malawi: a point prevalence survey. Bunduki GK, Feasey N, Henrion MYR, Noah P, **Musaya J.** *Infect Prev Pract*. 2021 Jul 24;3(3):100163. doi: 10.1016/j.infpip.2021.100163. PMID: 34430842.
3. Virulence factors and antimicrobial resistance of uropathogenic *Escherichia coli* (UPEC) isolated from urinary tract infections: a systematic review and meta-analysis. Bunduki GK, Heinz E, Phiri VS, Noah P, Feasey N, **Musaya J.** *BMC Infect Dis*. 2021 Aug 4;21(1):753. doi: 10.1186/s12879-021-06435-7. PMID: 34348646.
4. An Assessment of Implementation of Mass Drug Administration for Prevention and Control of Schistosomiasis and Soil-Transmitted Helminths in Selected Southern Malawi Districts-Makaula P, Kayuni S, Mamba K, Bongololo G, Funsanani M, **Musaya J,** Juziwelo LT, Furu P. *Preprint Research square* Dec 2021.

IV. Translation

The Neglected Tropical Diseases Group's contributions to translational science largely involve gathering data on trypanosomiasis and schistosomiasis in Malawi with a community-based and one health approach. These approaches strengthen intervention uptake and sustainability by communities and stakeholders. Our findings are then shared with other scientific researchers and policymakers so that they can be applied to improve health outcomes for Malawians.



Stool processing for *S.mansoni* eggs at a makeshift lab in Mangochi. © MLW. Photographer: Alexandra Juhász.



The HUGS field and lab team map the aetiology of schistosomiasis along Lake Malawi. © MLW. Photographer: Peter Makaula.

The opening of the CREATOR Building will be a very useful resource for the Group's post-graduate students, and, together with the newly created Themes, bring cross-cutting synergy for our researchers, students and collaborators that will deliver greater future translational benefit to Malawi.

The Group's most recent translational contributions include:

Engagement with policymakers

NTD team contributes to both membership of the AMR Technical Working Group (TWG), Malawi Ministry of Health and the Vector TWG, Malawi Ministry of Health.

V. Trainees in 2021

- **Peter Nambala**, PhD, 'Understanding the regulation of Trypanosome, human transcriptomes and Trypanosome genetic diversity in endemic Trypanosome brucei rhodesiense infections in Malawi', Supervisors: Musaya/Mulindwa, Malawian, Active
- **Kelita Kamoto**, PhD, 'Human genetic and immunological determinants of Trypanosoma brucei rhodesiense sleeping sickness in Malawi's endemic district of Rumphi', Supervisors: Musaya/Chisi, Malawian, Active
- **Yamikani Mbilizi**, Intern, Schisto FGS project, Supervisors: Musaya/Kayuni, Malawian, Active
- **Dorothy Moyo**, MSc, Antimicrobial stewardship project, Supervisors: Musaya/Banda, Malawian, Active
- **Maria Ndawala**, MSc, Antimicrobial stewardship project, Supervisors: Musaya/Muula, Malawian, Active
- **Jacquilene Chinkwita**, MSc, Antimicrobial stewardship project, Supervisors: Musaya/Nyirenda, Active
- **Happy Manda**, MSc, Antimicrobial stewardship project, Supervisors: Musaya/Nyirenda, Active
- **Alex Saidi**, MSc, Antimicrobial stewardship project, Supervisors: Musaya/Kawaza, Malawian, Active
- **Susan Mphande**, MPh, MapTryp project, Supervisor: Musaya, Malawian, Active

VI. Future vision

- More grant applications and collaborations.
- Increase our publications by encouraging students to write more manuscripts.
- Strategize for subgrouping to enrich diversity
- Training workshops for both group and individual growth
- Attract more interns



Dr Pui-Ying Iroh Tam (*right*) and her Paediatrics and Child Health team of clinician-researchers and educators aim to address Malawi children's health needs and to reduce Malawi's neonatal and child mortality. © MLW. Photographer: Hendrina Nkuta.

Paediatrics and Child Health

I. Overview

Created in 2016, the Paediatrics and Child Health (PCH) Group builds on a long history of paediatric research at MLW that began in the 1980s. Led by Dr Pui-Ying Iroh Tam, the PCH Group is primarily made up of clinician-researchers from the Paediatrics Department at Queen Elizabeth Central Hospital (QECH) and educators with the Department of Paediatrics, Kamuzu University of Health Sciences (KUHeS).

The PCH Group's child-centred research agenda aims to address Malawi children's health needs and reduce neonatal and child mortality (SDG 3.2). A multidisciplinary paediatric research collaboration, the PCH Group aims for policy relevance and impact in paediatric global health.

The Group's broad objectives are:

1. Determine and address translational research gaps for paediatrics and child health to reduce neonatal and child mortality and help Malawi achieve SDG 3.2; and
2. Create a paediatric research scientific network and collaborations to unify resources and improve child health indices in Malawi.

Specific research areas are:

1. Infectious conditions relevant to children in Malawi, primarily pneumonia, diarrhoeal disease, and bacterial sepsis, including those resistant to commonly prescribed antibiotics;
2. Nutrition, and impact of nutritional status on infectious morbidity, growth and neurodevelopment; and
3. Neurodevelopment in the critical first few years of life.

Since its inception, the Group has made huge strides in:

- Supporting junior researchers and trainees;
- Addressing clinical issues relevant to child health in Malawi; and
- Forming collaborations and networks with other health and research institutions in Malawi.

To build on this, over the coming years, the Group aims to:

- Continue to increase the number of Malawian trainees;
- Recruit more clinician-researchers; and
- Further local, national and international research networks in paediatrics and neonatal research.

PCH Group members are active at KUHeS, teaching MMed, MPH, MBBS, and BSc students, and in research activities, meetings and journal clubs.



Pui-Ying Iroh Tam (*3rd from right*) and colleagues receiving certificates of recognition for their involvement in the Malawi National Child Health Strategy 2021-2026 document. © MLW.

II. Scientific achievements 2021

The Paediatrics and Child Health Group continues to be very productive, with 11 papers published by MLW members in the Group in 2021. In that same period, an additional 14 publications have been published by MLW PCH Group affiliated members. Key results include:

Translational research gaps for paediatrics and child health

- Evaluated role of respiratory cryptosporidiosis in paediatric diarrhoeal disease, and the association with short-term growth (Iroh Tam et al., *PLoS Negl Trop Dis.* 2021; 15(7):e0009643. doi: 10.1371/journal.pntd.0009643; and Chisala et al., bioRxiv. 2021 Oct 14. doi: <https://doi.org/10.1101/2021.10.13.464207>).
- Documented bacteraemia among hospitalized children with malnutrition (Mukhula et al., *medRxiv.* 2021 Aug 21. doi: <https://doi.org/10.1101/2021.08.19.21262269>, manuscript in preparation).

Involvement in paediatric research networks and development of paediatric guidelines

- Core member of the Malawi National Child Health Strategy 2021-2026.
- Member of WHO and UNICEF Global Expert Consultation on Generic model for inpatient care of small or sick newborns.
- Developed national paediatric treatment guidelines with Paediatric and Child Health Association of Malawi (PACHA).
- Active engagement in PACHA organising and research committees.
- Organizing member of the National Paediatric and Child Health Research Working Group.
- Involved in developing and revising paediatric antimicrobial stewardship, Paediatric Intensive Care Unit guidelines and infection prevention activities in Mercy James Centre and paediatric wards at Queen Elizabeth Central Hospital.



Lughano Ghambi (*right*) participating in a radio programme discussing AMR and her work on AMR-related studies in children. © MLW.

III. Top 5 publications since 2020

These are the 5 most important papers published in 2021 by the Group and affiliated group members in scientific journals (related/group member names in **bold**):

1. Pharmacokinetics and pharmacodynamics of clofazimine for treatment of cryptosporidiosis. ZhangCX, LoveMS, McNamaraCW, ChiV, Woods AK, Joseph S, Schaefer DA, Betzer DP, Riggs MW, **Iroh Tam PY**, Van Voorhis WC, Arnold SLM. *Antimicrob Agents Chemother*. 2022 Jan 18; 66(1):e0156021. doi: 10.1128/AAC.01560-21. PMID:34748385.
2. Performance and safety of the induced sputum procedure in young children in Malawi: a prospective study. **Nyangulu W**, Thole H, Chikhoza A, Msakwiza M, Nyirenda J, **Chisala M**, **Iroh Tam PY**. *Trans R Soc Trop Med Hyg*. 2021 Nov1;115(11):1247-1250. doi: 10.1093/trstmh/trab151. PMID: 34590145.
3. Respiratory and diarrheal pathogens in Malawian children hospitalized with diarrhea and association with short-term growth. **Chisala MN**, **Nyangulu W**, Thole H, Nyirenda J, **Iroh Tam PY**. *bioRxiv*. 2021 Oct 14. doi: <https://doi.org/10.1101/2021.10.13.464207>. Under review, *PLoS Negl Trop Dis*.
4. The health policy response to COVID-19 in Malawi. **Mzumara GW**, Chawani M, Sakala M, Mwandira L, Phiri E, Milanzi E, Phiri MD, Kazanga I, O'Byrne T, Zulu EM, Mitambo C, Divala T, Squire B, **Iroh Tam PY**. *BMJ Glob Health*. 2021 May;6(5):e006035. doi: 10.1136/bmjgh-2021-006035. PMID: 34006521.
5. Respiratory cryptosporidiosis in Malawian children with diarrheal disease. **Iroh Tam PY**, **Chisala M**, **Nyangulu W**, Thole H, Nyirenda J. *PLoS Negl Trop Dis*. 2021 Jul 30;15(7):e0009643. doi: 10.1371/journal.pntd.0009643. PMID: 34329296.

IV. Translation

The Group's child-centred research agenda focuses on addressing Malawi children's health needs and reducing neonatal and child mortality. PCH Group projects represent the spectrum of translational research at MLW including basic science (T1), early-phase studies (T2), clinical trials (T3), and implementation science (T4). These translational projects and activities include:

Producing knowledge by conducting observational studies and trials

- Conducting active observational studies being in antimicrobial resistance and stewardship, pneumonia, diarrhoeal disease, vaccine efficacy, among others.
- Clinical trials focused on paediatric pneumonia, diarrhoea, and vaccines.

Evaluating child health policy

- Engagement with PACHA activities in Malawi.
- Member of Malawi Ministry of Health (MoH) Integrated Management of Childhood Illness Technical Working Group.

Strengthening health systems

- Involved with MoH stakeholders in active studies

Developing international collaborations and networks, through PRiSM-Malawi and PRiSM-Africa.

- PCH has relationships with investigators in Malawi (Ken Maleta, KUHeS; Mia Crampin, Malawi Epidemiology and Research Unit), Canada (Robert Bandsma, Hospital for Sick Children, Toronto), United Kingdom (Jay Berkeley, Oxford; Jonathan Wells, UCL; Marko Kerac, LSHTM), and Netherlands (Wieger Voskuil, Amsterdam University Medical Center).



Pre-MSc trainee Victoria Mukhula finishing up a supervisory meeting with Pui-Ying Iroh Tam. © MLW.

V. Trainees in 2021

- **Grace Mzumara**, MMed, 'Chest radiography in children with severe acute respiratory illness in era of pneumococcal conjugate vaccines', Supervisor: P-Y Iroh Tam, Malawian, Active
- **Lughano Ghambi**, MPH, 'Determinants of mortality in neonates with culture-negative sepsis at QECH: and implications for antimicrobial stewardship', Supervisor: P-Y Iroh Tam, Malawian, Active
- **Lucky Ngwira**, MSc, 'Determinants of neonatal mortality among hospitalised neonates in Malawi: a descriptive cross-sectional study at Queen Elizabeth Central Hospital', Supervisor: P-Y Iroh Tam, Malawian, Active
- **Noah Ntiza**, MPH, 'Clinical Features Associated with Invasive pneumococcal Disease in Children', Supervisor: P-Y Iroh Tam, Malawian, Active
- **John Ndaferankhande**, MSc, 'Stability of reconstituted valganciclovir subjected to domestic storage conditions by caregivers in the Empirical trial', Supervisor: P-Y Iroh Tam, Malawian, Active
- **Angella Chikhoza**, MPH, 'Assessment of uptake of COVID 19 vaccine among health care workers at QECH, Malawi', Supervisor: P-Y Iroh Tam, Malawian, Active
- **Mike Mambiya**, Pre-PhD Intern, 'The effect of nutrition on development and outcomes', Supervisor: P-Y Iroh Tam, Malawian, Active

VI. Future vision

- Increase support for pre-MSc and pre-PhD candidates .
- Increase number of MSc and PhD candidates.
- Build paediatrics research networks with partners and collaborators.
- Reputation for conducting excellent paediatric clinical studies and trials.
- Strengthen linkages with MoH and translating research into policy.



The Infectious Disease Epidemiology team use a people-focused strategy to assess novel malaria intervention and monitoring tools and surveillance strategies to inform malaria control. Clockwise from back left: Group Deputy Dr Latif Ndeketa, Group Head Dr Anja Terlouw, Dr Clifford Banda, Group Administrator Patience Korea, Tikhala Makhaza Jere and Phylis Mzanga. © MLW. Photographer: Zuze Matoliro.

Infectious Disease Epidemiology

I. Overview

With multi-disciplinary expertise in clinical epidemiology, pharmaco-epidemiology, mathematical modelling, geostatistics, social science and implementation research, the Infectious Disease Epidemiology Group assess novel malaria intervention and monitoring tools and surveillance strategies to inform control efforts that reduce the burden and transmission of malaria in Malawi and sub-Saharan Africa. The group is led by Dr Anja Terlouw and deputies Dr Donnie Mategula and Dr Latif Ndeketa, with administration support from Patience Korea.

The Group partner with national and global policymakers to generate evidence to inform policy decisions. Team members regularly collaborate with the Malawi National Malaria Control Programme (NMCP) and contribute to malaria Technical Working Groups (TWGs), task forces, advisory panels, and national and international policy engagement networks.

The Group collaborate with external and internal teams including MLW's Vector Biology, Clinical and Laboratory Malaria, Public Health, Biostatistics, Salmonella, Social science and Policy Unit teams (and related laboratories). Research is conducted from sites at Chikwawa District Hospital and St Monfort Hospital and the surrounding clinics and communities.

The Group have a people-focused strategy with a deliberate focus on training and mentorship of local and regional talent across the relevant epidemiology linked disciplines. They have developed a pool of competitive early-career scientists who now form the core of the group's identity. Since 2021, the Group's work and activities have focused on:

RTS,S malaria vaccine implementation research

- Assess the safety of the RTS,S malaria vaccine, when delivered in routine settings as part of a multi-country GSK-sponsored regulatory study (EPI-MAL-003). In these sites, they assess malaria parasite prevalence annually (GSK EPI-MAL-005);
- Assess the dynamics of healthcare utilization linked to the RTS,S/AS01 vaccine introduction.

Spatiotemporal monitoring to rapidly reduce malaria transmission

- Determine sub-district spatiotemporal clinical malaria incidence, using routine incidence data;
- Determine the predicted variation in parasite prevalence estimates from Malawi National Malaria Indicator Surveys that is due to the sampling design and determine if this could affect the interpretation on control progress over time.

Malaria treatment and intervention optimisation

- Determine the optimal dose of dihydroartemisinin-piperazine (DP) for malaria preventive treatment in infants;
- Assess the impact of DP, given for malaria preventive treatment in pregnancy, on subsequent risk of malaria in HIV exposed infants between 6 to 12 months of age;
- Assess if weekly prophylaxis with DP, alone or combined with azithromycin, in HIV-infected pregnant women on ARTs and daily cotrimoxazole improves current policies to control malaria and STIs/RTIs in high resistance areas, prevalence of STIs/RTIs and malaria in East and Southern Africa (IMPROVE-2).

II. Scientific achievements 2021

The Group's portfolio and outputs are representative of the focus on training and building multidisciplinary critical mass through collaboration and team science. Most Group members are progressing through various stages of their career training, capitalising on a vibrant research environment to build experience in large-scale population-based programmes:



Dr Latif Ndeketa interviewed on MBC about the WHO Malaria Vaccine recommendation on 7 October 2021. © MLW.

The Group published the findings of a single-site cluster-randomized controlled. The assessed interventions were community-driven larval source management and house improvement on malaria transmission when added to the standard malaria control strategies in Malawi.

RTS,S malaria vaccine implementation research

The Group are one of 7 sites of a three-country 5-year evaluation programme in Ghana, Kenya and Malawi to evaluate the Safety, Effectiveness and Impact of the GSK Malaria Vaccine- RTS, S/AS01E in 45,000 Young Children in Sub-Saharan Africa (<https://clinicaltrials.gov/ct2/show/NCT03855995>). The overall Malaria Vaccine

Implementation Programme (MVIP) led to Oct 2021 WHO recommendation of the RTS,S vaccine for use in children in sub-Saharan Africa.

Achieving critical mass in multidisciplinary expertise

In 2021, the Group reached a level of critical mass of epidemiologists who collectively represent a range of malaria disciplinary expertise, clinical epidemiology, population epidemiology, vaccine-epidemiology, clinical pharmacology, geostatistics and mathematical modelling. As group members

pursue their degree training in-country and abroad, this builds a professional network with other teams and allows the Group to pursue establishing a Centre for Epidemiological Modelling and Analyses (CEMA) at MLW within the next 3 years.

III. Top 5 publications since 2020

Policy-relevant papers that group members and trainees contributed to include:



Dr Kondwani Jambo (left) and Dr Latif Ndeketa during a COVID-19 media engagement event in 2021. © MLW. Photographer: Rachel Mhango.

1. The effect of community-driven larval source management and house improvement on malaria transmission when added to the standard malaria control strategies in Malawi: a cluster-randomized controlled trial. McCann RS, Kabaghe AN, Moraga P, Gowelo S, Mburu MM, Tizifa T, **Chipeta MG**, Nkhono W, Di Pasquale A, Maire N, Manda-Taylor L, Mzilahowa T, van den Berg H, Diggle PJ, **Terlouw DJ**, Takken W, van Vugt M, Phiri KS. *Malar J.* 2021 May 22;20(1):232. doi: 10.1186/s12936-021-03769-0. PMID:34022912.
2. The duration of protection from azithromycin against malaria, acute respiratory, gastro-intestinal and skin infections when given alongside seasonal malaria chemoprevention: secondary analyses of data from a clinical trial in Houndé, Burkina Faso and Bougouni, Mali. **Phiri MD**, Cairns M, Zongo I, Nikiema F, Diarra M, Yerbanga RS, Barry A, Tapily A, Coumare S, Thera I, Kuepfer I, Milligan P, Tinto H, Dicko A, Ouédraogo JB, Greenwood B, Chandramohan D, Sagara I. *Clin Infect Dis.* 2021 Oct 5;73(7):e2379-e2386. doi: 10.1093/cid/ciaa1905. PMID:33417683.
3. Cost-effectiveness and public health impact of RTS,S/AS01E malaria vaccine in Malawi, using a Markov static model. **Ndeketa L**, **Mategula D**, Terlouw DJ, Bar-Zeev N, Sauboin C, Biernaux S. *Wellcome Open Res.* 2021 Aug 12;5:260. doi: 10.12688/wellcomeopenres.16224.2. PMID:34632084.
4. Effect of bed net colour and shape preferences on bed net usage: a secondary data analysis of the 2017 Malawi Malaria Indicator Survey. **Mategula D**, **Ndeketa L**, Gichuki J, Zimba B, Ching'ani W, **Chipeta MG**. *Malar J.* 2020 Nov 23;19(1):428. doi: 10.1186/s12936-020-03499-9. PMID:33228732.
5. Childhood malaria case incidence in Malawi between 2004 and 2017: spatio-temporal modelling of climate and non-climate factors. **Chirombo J**, Ceccato P, Lowe R, **Terlouw DJ**, Thomson MC, Gumbo A, Diggle PJ, Read JM. *Malar J* 2020 Jan 6;19(1): 5. Doi: 10.1186/s12936-019-3097-z. PMID: 31906963.

IV. Translation

Group members actively engage with and contribute to translation of research and inform national and international decision-making and policy guidelines. In 2021, the Group contributed to a range of activities in Malawi, including:

- Involved in the national RTS,S MVIP coordination committee, and contributed to the policy process to approve the implementation of the vaccine in Malawi;

- Conducted analyses that inform NMCP activities, eg led a secondary data analysis of the 2017 Malawi Malaria Indicator Survey to assess if colour and shape affect bed net usage, which informed procurement decisions of nets for the 2021 national bed net distribution campaign;
- Reviewed structure and functionality of Ministry of Health (MoH) Technical Working Groups in enabling Evidence Informed Decision Making within the MoH. The work's findings are being incorporated into Malawi's Health Sector Strategic Plan 3;
- Supporting the national COVID response through committee membership and through the Kuteteza project, an implementation project for community-based responses to protect vulnerable and elderly people from COVID-19 in Malawi.



Dr Donnie Mategula submitting his PhD fellowship application. © MLW. Photographer: Donnie Mategula.

V. Trainees in 2021

- **Dr Clifford Banda**, PhD fellow, 'Optimising dosing of dihydroartemisinin-piperazine for malariapreventive treatment in Malawian infants (OPTIMAL)', Supervisors: Terlouw/Barnes, Malawian, active
- **Dr Donnie Mategula**, PhD fellow, 'Developing and validating an Early Warning System using geostatistical methods for heterogeneous transmission settings', Supervisors: Terlouw/Kuile/Giorgi. MRC-DTP Case PhD Fellowship, active
- **Ellen Gondwe**, Pre-PhD Intern, 'Mechanical understanding the potential of housing improvement and larval source management in Malawi', Supervisors: Terlouw/Sherrard-Smith, Malawian, active
- **Dr Richard Kamwezi**, MSc in Epidemiology (GSK MSc Scholarship for Future Health Leaders), London School of Hygiene and Tropical Medicine, UK, active
- **Dr Dumisile Nkosi**, MSc in Vaccinology and Drug Development, Institute of Global Health, Scholarship, University of Siena, Italy, active
- **Chimwemwe Ligomba**, MSc Epidemiology (WT PH&TM MSc fellowship), London School of Hygiene and Tropical Medicine, UK, active

VI. Future vision

Over the coming five years, we plan to contribute to the MLW institutional vision by establishing a Centre for Epidemiological Modelling and Analysis (CEMA). With an initial focus on malaria, in partnership with CEMA in Kenya and SACEMA in South Africa, we plan to develop this to include other infectious diseases.



Led by Todd Swarthout (*inset below*) and Deputy Head Akuzike Kalizang'Oma (*back row, 3rd from right*), the Pneumonia and Meningitis Pathogens Research Group team aims to reduce the disease burden from pneumonia and meningitis pathogens by focussing on vaccine evaluation and implementation. © MLW. Photographer: Hendrina Nkuta.

Pneumonia and Meningitis Pathogens

I. Overview

The Pneumonia and Meningitis Pathogens Group focuses on vaccine evaluation and accelerating vaccine implementation and preparedness, with the aim to reduce the disease burden from pneumonia and meningitis pathogens. Currently targeted pathogens include: i) *Streptococcus pneumoniae*, responsible for a high burden of severe disease disproportionately affecting those in resource-poor settings across Africa, and ii) the respiratory syncytial virus (RSV), the leading global cause of acute lower respiratory illness in infants and children. These are both vaccine preventable. We aim to optimise the impact of vaccination to ensure health equity.

The Group is co-led by Todd Swarthout (Senior Research Fellow with University College London, with honorary affiliations at Liverpool School of Tropical Medicine and University of Liverpool) and Akuzike Kalizang'oma (clinician and PhD student). Supported by Mernani Kaonga (Admin), the Group is staffed by experienced study coordinators, lab technicians, epidemiologists, research nurses and field workers. Aiming to be an internationally recognised site for vaccinology, the Group strives for excellence, strengthening links with basic scientists (microbiology, immunology, molecular biology) and policy makers (including social and economic science) and by fostering the professional development of emerging African public health scientists.



Todd Swarthout, Group Head

The Group has continued to build on the initial PCVPA Project which showed a sub-optimal vaccine-induced reduction in pneumococcal carriage after Malawi's 2011 PCV13 implementation. This has led to the Gates-funded PAVE Study, investigating the impact of a PCV13 booster dose to reduce carriage. Other works include investigating impact of PCV13 on incidence of invasive pneumococcal disease (IPD), and assessing impact of vaccine (RTS,S and PCV) on reducing antimicrobial resistance. The Group regularly engages with policymakers and technical Working Groups (TWG) including the WHO's PSERENADE and P-CARRIAGE projects. The Group has developed strong collaborative partnerships with infectious disease modelling research units, including Lancaster University and University of Oxford.



The Pneumonia and Meningitis Pathogens Research Group conducting IVAR study briefing and PAVE study progress update to health workers, Bangwe Health Centre. © MLW. Photographer: Zuze Matoliro.

We continue to develop robust methodological techniques that optimise sound and validated outputs from field research in often-challenging settings, filling a gap in the region routinely highlighted by leading policymakers. The Group also leads in global efforts to standardise pneumococcal testing strategies, from sample collection to processing, serotyping, and DNA extraction.

Recognising the health inequities between low- and middle-income countries (LMICs) and high-income countries (HICs), the Group prioritises research, work and activities that identify and address obstacles to achieving optimal vaccine impact, with a current focus on:

Optimising benefits of current WHO Expanded Programme on Immunization (EPI) vaccines (to reduce pneumonia and meningitis)

- Longitudinal and large-scale observational studies on vaccine efficacy in reducing colonization & disease;
- Cluster randomised trials investigating heterologous effects of vaccine schedules (big picture) in the context of potential schedule changes and an increasingly crowded schedule.

Protecting vulnerable populations with vaccination (including HIV-infected adults and pregnant women)

- Cohort and case-control studies of the burden and severity of respiratory pathogens in HIV- infected adults;

- Disease burden and severity studies in pregnant women and neonates, with focus on paediatric respiratory infections.

Investigate efficacy of novel vaccine candidates for existing or new targets

- Leverage collaborative capacity (within and external to research group) to establish a solid platform for evaluating new vaccines.

Achieve health equity

- Maintain the goal of achieving similar standards in individual access to quality vaccines with a population impact similar to that seen in high-income countries and identifying obstacles to that goal.



Research Group's Senior Laboratory Technician Jacqueline Msefula and Comfort Brown discuss lab results. © MLW. Photographer: Pauline Mlogeni.

II. Scientific achievements 2021

The Pneumonia and Meningitis Pathogens Group continue to be very productive, with 9 high-impact papers published in 2021, and these important activities:

Public engagement

- Extensive reporting of PCVPA and PAVE Study results to the Blantyre community;
- Ongoing outreach to and coverage by local media, including coverage regarding results among SARS-CoV-2 exposure using blood donor samples and presenting [to Ministry of Health (MoH) and Ministry of Education, WHO,

UNICEF and local community stakeholders] the ongoing PAVE Study to assess a PCV13 2+1 vaccine schedule;

- Regular contributors to internal communications, including MLW website and newsletter, including articles on the PAVE study.

III. Top 5 publications since 2020

These are the most important of the 9 papers published in scientific journals in 2021 by the Pneumonia and Meningitis Pathogens Group (group member names in bold):

1. Invasive Pneumococcal Disease in infants less than 90 days of age before and after introduction of the 13-valent Pneumococcal Conjugate Vaccine in Blantyre, Malawi: a retrospective analysis. Marianne Koenraads, **Swarthout TD**, Bar-Zeev N, **Brown C**, **Msefula J**, Denis B, Queen Dube, Gordon SB, Heyderman RS, Gladstone M, French N. *MedRxiv*. 2021.08.18.21262215; <https://doi.org/10.1101/2021.08.18.21262215>
2. Dynamics of SARS-CoV-2 exposure in Malawian blood donors: a retrospective seroprevalence analysis between January 2020 and February 2021. Mandolo J, **Msefula J**, Henrion MYR, **Brown C**, Moyo B, Moyo-Gwete T, Makhado Z, Ayres F, Kalata N, Muula A, Kwatra G, Moore PL, French N, Heyderman RS, **Swarthout TD**, Jambo KC. *BMC Med*. 2021 Nov 19;19(1):303 <https://doi.org/10.1186/s12916-021-02187-y>. PMID:34794434.
3. Impact and effectiveness of 13-valent pneumococcal conjugate vaccine on population incidence of vaccine and non-vaccine serotype invasive pneumococcal disease in Blantyre, Malawi, 2006–18: prospective observational time-series and case-control studies. Bar-Zeev N,

Swarthout TD, Everett DB, Alaerts M, **Msefula J**, **Brown C**, Bilima S, Mallewa J, King C, Gottberg Av, Verani JR, Whitney CG, Mwansambo C, Gordon SB, Cunliffe NA, French N, Heyderman RS. *Lancet Glob Health*. 2021 Jul;9(7):e989–e998. [https://doi.org/10.1016/S2214-109X\(21\)00165-0](https://doi.org/10.1016/S2214-109X(21)00165-0). PMID: 34143997

4. Hepatitis B vaccination impact and the unmet need for antiviral treatment in Blantyre, Malawi. Stockdale AJ, Meiring JE, Shawa IT, Thindwa D, Silungwe NM, Mbewe M, Kachala R, Kreuels B, Patel P, Patel P, Henrion MYR, Bar-Zeev N, **Swarthout TD**, Heyderman RS, Gordon SB, Geretti AM, Gordon MA. *J Infect Dis*. 2021 Nov 9;jiab562. doi: 10.1093/infdis/jiab562. PMID:34752631.
5. A pragmatic health centre-based evaluation comparing the effectiveness of a PCV13 schedule change from 3+0 to 2+1 in a high pneumococcal carriage and disease burden setting in Malawi: a study protocol. **Swarthout TD**, Ibarz-Pavon A, Kawalazira G, **Sinjani G**, Chirombo J, Gori A, **Chalusa P**, **Bonomali F**, **Nyirenda R**, **Bulla E**, **Brown C**, **Msefula J**, Banda M, Kachala J, Mwansambo C, Henrion M, Gordon SB, French N, Heyderman RS. *BMJ Open*. 2021 Jun 17;11(6):e050312. <http://dx.doi.org/10.1136/bmjopen-2021-050312>. PMID:34140345.

IV. Translation

Research work by the Pneumonia and Meningitis Pathogens Group that translates into a health benefit for Malawians includes:

- Translating pneumococcal carriage prevalence data into discussions with the Malawi MoH to consider changing the PCV13 dosing schedule from the current 3+0 to a 2+1 schedule;
- Launching a study to assess the impact of a 2+1 on vaccine serotype carriage;
- Engaging the MLW Policy Unit team with our findings and liaising with them to optimise our potential for influencing policy; and
- Advocating for implementation of standardised laboratory techniques to ensure institutional outputs that are institutionally consistent and comparable to other regional and international research institutions.



Research Group's field team jointly discussing the work plan with Health Surveillance and Community Health Volunteers. © MLW. Farouck Bonomali.

V. Trainees

- **Akuzike Kalizang'oma**, PhD fellow, 'Streptococcus mitis antimicrobial resistant patterns', Supervisors: R Heyderman/B Kwambana, Malawian, Active

VI. Future vision

The Group will continue to implement research to optimise vaccination strategies. This includes:

- Leveraging opportunities to implement Phase II vaccine trials for vaccine candidates for RSV and higher-valency PCV vaccines;
- Building the Group's training pipeline; and
- Continuing to pursue collaborations (local and international) that optimise strategies to reduce the burden of disease caused by pneumonia and meningitis pathogens.



Infection and Immunity Lead Kondwani Jambo (*front, middle*) and his team use their skills in immunology, microbiology and clinical medicine to conduct research on human immunity against viral and bacterial pathogens. © MLW. Photographer: Pauline Mlogeni.

Infection and Immunity

I. Overview

The Infection and Immunity Research Group (formerly Viral Immunology) conduct world-class research that enhances our understanding of human immunity against viral and bacterial pathogens, while training the next generation of low- and middle-income country (LMIC)-based biomedical and clinician-scientists. The Group achieve this with cutting-edge immunology and microbiology laboratory platforms, an award-winning training programme, and a vibrant engagement initiative with national policymakers and the public. Our vision is to become a leading LMIC research group for training in mucosal immunology and providing immunological assays for public health and vaccine testing in Africa.

Dr Kondwani Jambo, supported by Deputy Group Head Dr Marah Chibwana and Group Administrator Mernani Kaonga, heads a dynamic group of 25 researchers with skills in immunology, microbiology and clinical medicine. The Group manages the MLW Immunology Laboratory, the Flow Cytometry Core facility and the MLW Serology Facility. Dr Jambo is Co-Chair of the MLW/Kamuzu University of Health Sciences Training Committee, and member of the MLW Research Strategy Group and of the MLW Lab Steering Committee.

Together with local and international collaborators, the Infection and Immunity Group is currently working on:

- Investigating how HIV evades cytolytic immunity in the lung and gut mucosa;
- Determining the host and bacterial factors promoting persistence of pneumococcal carriage in ART-experienced HIV-infected adults;
- Assessing the efficacy of pneumococcal conjugate vaccines (PCV) in reducing pneumococcal carriage and transmission in adults from a high transmission setting;
- Discovering the serological and cellular immune markers associated with immunity against COVID-19; and
- Developing tools to assess population level immunity against vaccine-preventable diseases in LMIC settings.

II. Scientific achievements 2021

The Infection and Immunity Group continue to be very productive, with 10 papers published in 2021, and achieving these Important results:



Christine Mandalasi, Pre-MSc Intern, in MLW's Cellular Immunology Laboratory. © MLW. Photographer: Alick Chimzere, Creative Works.

- Group members made significant contributions to Malawi's national COVID-19 pandemic response and took a leading role in COVID-19 immunology research. In 2021, the Group was awarded grants to assess COVID-19 vaccine safety (GAVI) and effectiveness (WHO and BMGF) in Malawi. They were also awarded a multidisciplinary grant to set up a multi-disease sero-surveillance platform in Malawi that includes SARS-CoV-2 and other vaccine-preventable diseases.
- Members of the Group provided expert advice through a policy recommendation on the use of COVID-19 booster doses to the Ministry of Health (MoH), through the COVID-19 Expert Committee and the special Malawi National Immunization Technical Advisory Group (MAITAG).

III. Top 5 publications since 2020

These are the most important of the 10 papers published in scientific journals in 2021 by the Viral Immunology Group (group member names in **bold**):

1. SARS-CoV-2 exposure in Malawian blood donors: an analysis of seroprevalence and variant dynamics between January 2020 and July 2021. **Mandolo J**, Msefula J, Henrion MYR, Brown C, Moyo B, Samon A, Moyo-Gwete T, Makhado Z, Ayres F, Motlou T, Mzindle N, **Kalata N**, Muula AS, Kwatra G, Nsamala N, Likaka A, Mfuno T, Moore PL, Mbaya B, French N, Heyderman RS, Swarthout T, **Jambo KC**. *BMC Med*. 2021 Nov 19;19(1):303. doi: 10.1186/s12916-021-02187-y. PMID: 34794434.
2. Distinct clinical and immunological profiles of patients with evidence of SARS-CoV-2 infection in sub-Saharan Africa. Morton B, Barnes KG, Anscombe C, Jere K, Matambo P, **Mandolo J**, **Kamng'ona R**, Brown C, Nyirenda J, Phiri T, Banda NP, Van Der Veer C, Mndolo KS, Mponda K, Rylance J, Phiri C, Mallewa J, Nyirenda M, Katha G, Kambiya P, Jafali J, Mwandumba HC, Gordon SB; Blantyre COVID-19 Consortium, Cornick J, **Jambo KC**. *Nat Commun*. 2021 Jun 11;12(1):3554. doi: 10.1038/s41467-021-23267-w. PMID: 34117221.
3. A feasibility study of controlled human infection with *Streptococcus pneumoniae* in Malawi. Morton B, Burr S, Chikaonda T, Nsomba E, Manda-Taylor L, Henrion MYR, Banda NP, Rylance J, Ferreira DM, **Jambo K**, Gordon SB; MARVELS consortium. *EBioMedicine*. 2021 Oct;72:103579. doi: 10.1016/j.ebiom.2021.103579. Epub 2021 Sep 24. PMID: 34571365.

4. Single cell analysis of *M. tuberculosis* phenotype and macrophage lineages in the infected lung. Pisu D, Huang L, Narang V, Theriault M, Lê-Bury G, Lee B, **Lakudzala AE, Mzinza DT, Mhango DV**, Mitini-Nkhoma SC, **Jambo KC**, Singhal A, Mwandumba HC, Russell DG. *J Exp Med*. 2021 Sep 6;218(9):e20210615. doi: 10.1084/jem.20210615. Epub 2021 Jul 22. PMID: 34292313.
5. MicroRNA-29 specifies age-related differences in the CD8+ T cell immune response. Yee Mon KJ, Zhu H, Daly CWP, Vu LT, Smith NL, Patel R, Topham DJ, Scheible K, **Jambo K**, Le MTN, Rudd BD, Grimson A. *Cell Rep*. 2021 Nov 9;37(6):109969. doi: 10.1016/j.celrep.2021.109969. PMID:34758312.

IV. Translation

The Infection and Immunity Group continues to actively translate scientific bench work into policy. The Group's translation work includes:



Research Assistant Jonathan Mandolo working in the MLW serology laboratory. © MLW. Photographer: Alick Chimzere, Creative Works.

- Active involvement in providing evidence on prevalence of SARS-CoV-2 in Malawi through the SERO-PROTECT Study to aid policy and national strategic prioritisation;
- Submission of a policy recommendation on COVID-19 booster doses to the Government of Malawi through the COVID-19 Expert Group and MAITAG;
- Establishing a high throughput serology laboratory at MLW accessible by the Public Health Institute of Malawi (PHIM); and
- Winning two grants with direct translation potential, the COVID-19 vaccine safety study (VACSAFE; GAVI) and COVID-19 vaccine effectiveness study (VAXEF; WHO and BMGF) studies.

V. Trainees

- **Leonard Mvaya**, PhD fellow, 'Understanding the role of CD8+ T cell effector function and localization in the seeding of HIV reservoirs in the duodenal mucosa', Supervisors: K Jambo/Z Ndhlovu, Malawian, Active
- **Lusako Sibale**, PhD fellow, 'Impact of prolonged carriage of *Streptococcus pneumoniae* on emergence and spread of antimicrobial resistance among ART-experienced people living with HIV in Malawi', Supervisors: K Jambo/B Kwambana/ A Kamng'ona, Malawian, Active
- **Joseph Phiri**, PhD fellow, 'Defining changes in nasal immunity that favours propensity for increased pneumococcal carriage in people living with HIV', Supervisors: K Jambo/B Kumwenda/D Ferreira, Malawian, Active
- **Aaron Chirambo**, PhD fellow, 'Polycytotoxic T lymphocytes in the human lung during latent tuberculosis infection and pulmonary tuberculosis disease', Supervisors: H Mwandumba/K Jambo/S Stenger, Malawian, Active
- **Chikondi Malamba**, PhD fellow, 'Immunological factors contributing to underperformance of Rotavirus vaccine effectiveness in Malawi', Supervisors: K Jere/K Jambo/M Iturizza-Gomara, Malawian, Active
- **David Mhango**, PhD fellow, 'Transcriptome profiling of human alveolar macrophages to probe heterogeneity and control of *Mycobacterium tuberculosis* infection', Supervisors: H Mwandumba/K Jambo/D Dockrell, Malawian, Active



Thokozani Kayembe, Pre-MSc Intern, working in the MLW Microbiology Laboratory. © MLW. Photographer: Alick Chimzere, Creative Works.

- **Deus Thindwa**, PhD fellow, 'Vaccine strategies to reduce the burden of invasive pneumococcal disease in immunocompromised adults', Supervisors: S Flasche/N French, Malawian, Active
- **Agness Lakudzala**, Pre-PhD Intern, 'Profiling naturally induced humoral immunity against invasive non-typhoidal *Salmonella* using systems serology', Supervisors: M Gordon/K Jambo/T Nyirenda, Malawian, Active
- **Dr Marah Chibwana**, MSc Student, University of Oxford-Felix Scholarship, Supervisor: K Jambo, Malawian, Active
- **Chisomo Jassi**, BSc Social Science (Monitoring and Evaluation), Catholic University, Malawian, Active
- **Ndaona Mitole**, BSc Social Science (Development Studies), Catholic University, Supervisor: R Katundu, Malawian, Completed 2021
- **Leah Mulira**, BSc Social Science (Development Studies), Catholic University, Supervisor: E Masoambeta, Malawian, Completed 2021
- **Alice Kusakala**, BSc Social Science (Development Studies), Catholic University, Supervisor: E Masoambeta, Malawian, Completed 2021



Counter-clockwise, from right: Group Lead Kondwani Jambo meets with Study Coordinator (clinical) Steven Kateta, Research Assistant (lab) Mphatso Chaponda, Fieldworker Randy Sibale, Creative Practitioner MacFarlane Mbewe, and Research Nurse Wezzie Chimang'anga. © MLW. Photographer: Alick Chimzere, Creative Works.

VI. Future vision

- To establish a robust multi-disease sero-surveillance platform to inform policy on vaccine-preventable diseases.
- To test interventions for reducing residual pneumococcal carriage among people living with HIV on antiretroviral therapy.
- To gain mechanistic insights on the regulation of cytolytic cells in the mucosa tissues.
- To provide immunological assays to the local scientific community in Malawi for assessing vaccine-induced immunity for in-country investigator-led vaccine trials.



Clinical and Laboratory Malaria Lead Karl Seydel (2nd row, right) and his team work to understand why infection with *Plasmodium* malaria parasites results in a wide variety of symptoms, how to predict severe disease, and how to mitigate malaria's long-term consequences. © MLW. Photographer: Pauline Mlogeni.

Clinical and Laboratory Malaria

I. Overview

Caused by *Plasmodium* parasite infection transmitted by *Anopheles* mosquitoes, malaria continues to have a huge impact on sub-Saharan Africa, which in 2021 accounted for approximately 94% of the world's 241 million malaria cases and 627,000 malaria deaths, more than two-thirds in children under five – a rise of 21-million cases and 208,000 deaths compared with 2019. This increase is thought to be largely due to disruptions in diagnosis, treatment and prevention during the Covid-19 pandemic as well as increases in insecticide and drug resistance.

Led by Associate Professor Karl Seydel and Deputy Head Senior Lecturer Chris Moxon, the Clinical and Laboratory Malaria Group work to understand:

- Why infection with *Plasmodium* malaria parasites results in a wide variety of symptoms, ranging from mild or absent to severe, life-threatening disease;
- How to predict severe disease; and
- How to mitigate malaria's long-term consequences.

To do this, the Group recruit patients with different malaria disease severities, then use a variety of cellular and molecular techniques on both parasites and humans to determine the factors which lead to the different disease outcomes.

Comprising a diverse group of paediatricians, intensivists, infectious disease specialists and basic scientists, the Clinical and Laboratory Malaria group work in the laboratories at MLW as well as labs embedded within the Kamuzu University of Health Sciences (KUHeS). The Group's current malaria research and activities focus on:

Severity spectrum of malaria

Understanding the host and parasite factors that contribute to malaria's wide spectrum of disease severity:



Nurses confer over a patient on the Paediatric Research Ward. © MLW. Photographer: Nicole O'Brien.

- Collect well-characterised patient and parasite specimens from both ends of the disease severity spectrum;
- Characterise patient specimens immunologically; using high-dimensional imaging and transcriptomics;
- Characterise parasite specimens biologically, proteomically and genomically.

Malaria infection prognosis predictors

Determining the malarial disease characteristics that portend poor clinical outcome and if they can be altered:

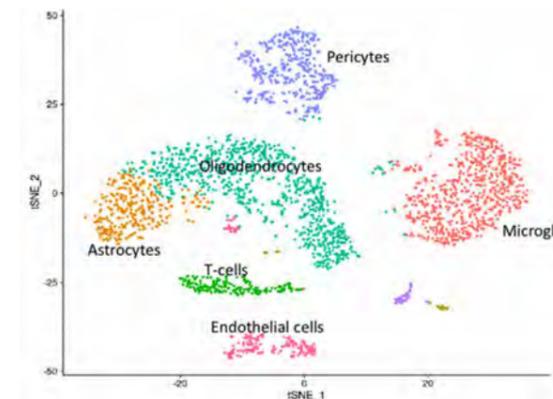
- Collect plasma and RNA samples from a subset of retinopathy-positive CM patients with swollen brains for proteomics and gene expression profiling.

Aetiologies of coma

Investigating different pathways to coma, including malarial and non-malarial, and comparing mortality and morbidity outcomes of these:

- Childhood aetiologies of severe encephalopathy;
- Universal antipyretics trial.

Looking forward, the Clinical and Laboratory Malaria Group see exciting possibilities to expand the scope of its research activities and collaborations, develop new African scientists, and provide greater health benefits to people living in malaria endemic zones in Malawi and sub-Saharan Africa:



t-distributed stochastic neighbour embedding (tSNE) dimension reduction plot summarising output from single cell RNA-sequencing from a child with fatal non-cerebral malaria encephalopathy demonstrating recovery of all major CNS cell types. All cell portioning and library preparation done in Malawi. © MLW.

- The Group anticipates more interactions, overlapping projects, and possibilities of co-mentored interns and students with MLW's Vector Biology Group;
- Deputy Head Chris Moxon has, through the University of Glasgow and funding from Scottish Government, obtained Malawi's first 10X Chromium machine to process samples for single cell RNA sequencing. The group has generated single cell data from blood cells (malaria, COVID-19) and lung, brain, and nasal tissue samples (COVID-19, Pneumonia, Malaria).

II. Scientific achievements 2021

The Clinical and Laboratory Malaria Group continues to be very productive, with 14 papers published in 2021. Key results include:

- MMP8 is associated with vascular leak in the retina of children who die of cerebral malaria while not in the retinas of those with mild malaria and death of another cause (*Clin Transl Immunology*. 2021 Apr 29;10(4))
- The developmental stage of malaria parasites in the peripheral blood differs among children with different disease severities (*Nat Commun*. 2021 Jul 30;12(1):4711)
- Determinants of brain swelling and death from cerebral malaria are similar in adults and children in Africa and India (*JCI Insight*. 2021 Sep 22;6(18):e145823)
- Pipecolic acid is a mediator of coma in a mouse model of cerebral malaria (*J Infect Dis*. 2021 Dec 21)

Public engagement

- Working with Deborah Nyrienda, Rachel Mhango and two local theatre companies, the Group have developed 3 videos to help dispel negative rumours around COVID-19 in the community.

III. Top 5 publications since 2020

These are the most important of the 14 papers published in scientific journals in 2021 by the Clinical and Laboratory Malaria Group:

1. Localised release of matrix metalloproteinase 8 in fatal cerebral malaria. Georgiadou A, Naidu P, Walsh S, Kamiza S, Barrera V, Harding SP, **Moxon CA**, Cunningham AJ. *Clin Transl Immunology*. 2021 Apr 29;10(4):e1263. doi: 10.1002/cti2.1263. PMID: 33968402.
2. Plasmodium falciparum Gametocyte Density and Infectivity in Peripheral Blood and Skin Tissue of Naturally Infected Parasite Carriers in Burkina Faso. Meibalan E, Barry A, Gibbins MP, Awandu S, Meerstein-Kessel L, Achcar F, Bopp S, **Moxon C**, Diarra A, Debe S, Ouédraogo N, Barry-Some I, Badoum ES, Fagnima T, Lanke K, Gonçalves BP, Bradley J, Wirth D, Drakeley C, Guelbeogo WM, Tiono AB, Marti M, Bousema T. *J Infect Dis*. 2021 May 28;223(10):1822-1830. doi: 10.1093/infdis/jiz680. PMID: 31875909.
3. Determinants of brain swelling in pediatric and adult cerebral malaria. Sahu PK, Duffy FJ, Dankwa S, Vishnyakova M, Majhi M, Pirpamer L, Vigdorovich V, Bage J, Maharana S, **Mandala W**, Rogerson SJ, **Seydel KB**, **Taylor TE**, Kim K, Sather DN, Mohanty A, Mohanty RR, Mohanty A, Pattnaik R, Aitchison JD, Hoffmann A, Mohanty S, Smith JD, Bernabeu M, Wassmer SC. *JCI Insight*. 2021 Sep 22;6(18):e145823. doi: 10.1172/jci.insight.145823. PMID: 34549725.
4. Whole-genome analysis of Malawian Plasmodium falciparum isolates identifies possible targets of allele-specific immunity to clinical malaria. Shah Z, Naung MT, Moser KA, Adams M, Buchwald AG, Dwivedi A, Ouattara A, **Seydel KB**, Mathanga DP, Barry AE, Serre D, Laufer MK, Silva JC, Takala-Harrison S. *PLoS Genet*. 2021 May 25;17(5):e1009576. doi: 10.1371/journal.pgen.1009576. PMID: 34033654.
5. Plasmodium falciparum transcription in different clinical presentations of malaria associates with circulation time of infected erythrocytes. Thomson-Luque R, Votborg-Novél L, Ndovie W, Andrade CM, Niangaly M, **Attipa C**, Lima NF, Coulibaly D, Doumtabe D, Guindo B, Tangara B, Maiga F, Kone AK, Traore K, Kayentao K, Ongoiba A, Doumbo S, Thera MA, Traoré B, **Seydel K**, Osório NS, Portugal S. *Nat Commun*. 2021 Jul 30;12(1):4711. doi: 10.1038/s41467-021-25062-z. PMID: 34330920

IV. Translation

The Clinical and Laboratory Malaria Group actively work on scientific research and studies whose results translate into health benefits for patients infected with malaria and lead to policy changes in Malawi and sub-Saharan Africa. These include:

- Leading clinical trial that examined if antipyretics reduce sequelae in cerebral malaria;
- Directing clinical trial of hypertonic saline to reduce mortality and morbidity in cerebral malaria via reducing brain volume;
- Screening novel non-anticoagulant Heparin analogues to assess their capacity to prevent malaria parasite induced Blood brain barrier breakdown in vitro.

V. Trainees

- **Stephen Ray**, PhD fellow, 'Childhood aetiologies of severe encephalopathy', Supervisors: Griffiths/Seydel, British, Active

- **Charalampos Attipa**, PhD fellow, 'The role of neutrophils and histones in endothelial activation during cerebral malaria', Supervisors: Craig/Moxon, Greek, Active
- **Sarah McNitt**, DO/PhD program, Michigan State University, Supervisor: Karl Seydel, American, Active



Syze Gama prepares a qPCR plate in the KUHeS laboratory. © MLW. Photographer: Monica Soko.

- **Alex Saidi**, MSc Antimicrobial Stewardship, KUHeS, Malawian, Active
- **Godfrey Mvula**, MSc Epidemiology, KUHeS, Malawian, Active
- **Syze Gama**, MSc Epidemiology, KUHeS, Malawian, Active

VI. Future vision

- We have two ongoing clinical trials (Fever and TBS studies) the results of which will inform future work;
- Expanding discovery research, aimed at a greater understanding of malaria pathogenesis and identifying treatment targets. To do this we are using high-dimensional multi-omic approaches to investigate host/pathogen interactions in patient samples and post-mortem tissue;
- Using systems immunology approaches including single cell RNA-sequencing to understand how malaria and other parasitic infections impact immune system development and responses to routine childhood vaccinations;
- Expanding the use of point-of-care imaging to understand physiological changes in CM and encephalopathies and how these link with patient outcome. These include a ward-based MRI, transcranial Doppler (TCD), Near-Infrared Spectroscopy (NIRS), Ultrasonic Cardiac Output Monitor (USCOM) and point-of-care ultrasound.



The Early Life Infection Group develop and evaluate effective, sustainable interventions that reduce paediatric mortality secondary to infection, and work to assess the impact of COVID-19 on these interventions. © MLW. Photographer: Hendrina Nkuta.

Early Life Infection

I. Overview

Made up of paediatricians, obstetricians, public health specialists, infectious disease specialists, social scientists and health economists, the Early Life Infection Group use a collaborative “team science” approach to develop and evaluate interventions that reduce paediatric mortality secondary to infection. The Group’s work now also assesses the direct and indirect effects of COVID-19 on these indicators.

Early Life Infection is led by an all-female team, Group Head Dr Bridget Freyne and Deputy Head Dr Maryke Nielsen, with a mission to identify and develop local research capacity and talent, and to participate in making MLW gender balanced, inclusive and diverse.

To reduce under-5 mortality from infection in Malawi, the Group will develop and evaluate effective, sustainable interventions that:

1. Reduce adverse birth outcomes and perinatal mortality secondary to infection;
2. Improve in-patient paediatric care quality and reduce central and district hospital mortality.

II. Scientific achievements 2021

The Early Life Infection Group continues to be very productive. Key results since January 2021 include:

1. Reducing adverse birth outcomes and perinatal mortality secondary to infection

- Syph_STAT completed data collection at 6 sites across Malawi including cross-sectional survey data on 8469 women at ANC and 4663 women at delivery and 50 semi-structured interviews with pregnant women, healthcare providers and policy makers. In addition, James Chirombo (SSU) analysed national HMIS data on the prevalence of gestational syphilis from 2010-2021 to generate a sub-regional analysis of the spatio-temporal trends in gestational syphilis in Malawi over the last decade.
- The PeriCOVID study completed recruitment of 400 mother infant pairs at Queen Elizabeth Central Hospital (QECH). The data from this study will be analysed in collaboration with the PeriCOVID consortium and the WHO Department of Maternal, newborn, child and adolescent health (MNCAH).
- The DIPLO_STI study has recruited 372 mother infant pairs at QECH in a case-control study designed to determine the prevalence of common sexually transmitted infections (STIs) in women attending QECH and any association with adverse birth outcomes.

2. Improving in-patient paediatric care quality and reducing central and district hospital mortality

- The COCoronavirus in Children and neonates in Malawi-Quality of Care (COCOA-QoC) study has completed pilot implementation of an in-patient quality of care data dashboard for the QECH Department of Paediatrics. The dashboard is reviewed weekly as part of routine departmental morbidity and mortality review (Fig 2). The study results illustrating the harmful indirect effects of the COVID-19 pandemic on child health was presented at the Kamuzu University of Health Sciences (KUHeS) Research Dissemination meeting 2021.
- The results of the ABCD trial (The Antibiotics for Children with Diarrhea) concluded that there was no additional evidence for the addition of empiric Azithromycin in the management of children with moderate to severe diarrhoea without dysentery.
- The COCOA International Severe Acute Respiratory and Emerging Infection Consortium (IS-ARIC) study collects data on the clinical presentation and laboratory characteristics of children hospitalised with COVID-19 at QECH with data being shared across the ISARIC platform.



Snapshot of the COCOA-QoC dashboard which is reviewed weekly in the Department of Paediatrics. Pictured are the key Infection and Prevention metrics across wards. © MLW.

III. Top 5 publications 2021

These are the most important of the 11 papers published in scientific journals in 2021 by the Early Life Infection Group (group member names in bold):

1. Effect of 3 Days of Oral Azithromycin on Young Children With Acute Diarrhea in Low-Resource Settings: A Randomized Clinical Trial. Antibiotics for Children With Diarrhea (ABCD) **ABCD Study Group**. *JAMA Netw Open*. 2021 Dec 1;4(12):e2136726. doi:10.1001/jamanetworkopen.2021.36726. PMID: 3491398.
2. Interventions to reduce preterm birth and stillbirth and improve outcomes for babies born preterm in low- and middle-income countries: A systematic review. Wastnedge E, Waters D, Murray SR, McGowan B, **Chipeta E, Nyondo-Mipando AL, Gadama L, Gadama G, Masamba M, Malata M, Taulo F, Dube Q, Kawaza K**, Khomani PM, Whyte S, Crampin M, **Freyne B**, Norman JE, Reynolds RM; DIPLOMATIC Collaboration. *J Glob Health*. 2021 Dec 30;11:04050. doi: 10.7189/jogh.11.04050. eCollection 2021. PMID: 35003711.
3. Lessons learnt from the rapid implementation of reusable personal protective equipment for COVID-19 in Malawi. Limani F, Garley D, Cocker D, Patel P, Patel P, Gordon S, Nyirenda M, Sakala S, Gadama L, dube Q, Bodole F, Kwazizira SM, Mponda K, **Freyne B**. *BMJ Global Health* 2021 Sep;6(9):e006498. doi: 10.1136/bmjgh-2021-006498.
4. Prevention of infant eczema by neonatal bacille Calmette-Guérin vaccination: The MIS BAIR randomized controlled trial. Pittet LF, Messina NL, Gardiner K, **Freyne B**, Abruzzo V, Francis KL, Morrison C, Zufferey C, Vuillermin P, Allen KJ, Ponsonby AL, Robins-Browne R, Shann F, Flanagan KL, Phillips R, Donath S, Casalaz D, Curtis N. *Allergy*. 2021 Jul 26. doi: 10.1111/all.15022. Online ahead of print. PMID: 34309859.
5. **Freyne B, Chaziya J, Lissauer S, Nielsen M**, Langton J, O'Hare B, Molyneux L, Moxon C, Iroh Tam PY, **Hoskyns L, Masanjala H**, Ilepere S, Ngwira M, Kawaza K, Mumba D, Chimalizeni Y, Dube Q; Department of Paediatrics, Queen Elizabeth Central Hospital. COVID-19 in Malawi: lessons in pandemic preparedness from a tertiary children's hospital. *Arch Dis Child*. 2021 Mar;106(3):238-240. PMID: 33361067.

IV. Translation

The Early Life Infection Group's contributions to translational science include:

Development of Malawian research talent

- All 4 MPH students on the Syph_STAT study submitted their Master's dissertations and one has received a scholarship for onward study at the University of Ibadan in Nigeria.
- Our MLW based interns, Elias Phiri and Diana Kulanga, presented data from the COCOA-QoC project at the KUHeS Research Dissemination Conference.
- Trainees associated with our group, James Chirombo (SSU MLW) and Monica Malata (CRH KUHeS), are preparing manuscripts associated with the Syph_STAT study in their chosen areas of expertise, epidemiological modelling, and health economics respectively.
- The Group's Wellcome Clinical PhD fellows, Maryke Nielsen and Amir Kirolos, are continuing with their studies under co-supervision.



Zione Pondani and Smart Njowa, the PeriCOVID Malawi clinical team at QECH © MLW. Photographer: Hendrina Nkuta.

Contributions to policy

- Participated in the adaptation of international policies to prevent and manage COVID-19 in Malawi, including the development of national paediatric guidelines.
- Presented the aims and methods of the SYPH_STAT study to the Malawi MoH Reproductive Health Directorate TWG and the WHO MNCAH country lead.
- The publication of the ABCD trial results by the WHO Department of MNCAH was an important contribution to the evidence base for the management of moderate-severe diarrhoea in children under 5 globally.
- The PeriCOVID study has a data sharing agreement with the WHO Department of MNCAH, which through the multinational COVID-19 pregnancy cohort is developing an accurate picture of the effect of COVID-19 on pregnancy across all WHO regions.

Working with Industry

The Group is working with industry partners Roche and Mologic to evaluate and optimise diagnostics, including point of care tests, for management of early onset neonatal infection in Malawian mothers and newborns.

V. Trainees in 2021

- **Maryke Nielsen**, PhD fellow, 'Maternal risk factors and biomarkers for prediction of early onset neonatal infection', Supervisors: French/Carroll/Freyne, British, Active
- **Amir Kirolos**, PhD fellow, 'Longterm outcomes of severe childhood malnutrition', Supervisors: Gladstone/Kerac/S Lissauer/Freyne, British, Active
- **Kondwani Kaunda**, MSc Public Health, Malawian, Active
- **Harrison Sikilawa**, MSc Public Health, Malawian, Active
- **Zacharia Kafuwa**, MSc Public Health, Malawian, Active
- **Naomi Mkutche**, MSc Reproductive Health, Malawian, Active
- **Diana Kululanga**, MSc Global Health, Malawian, Active

VI. Future vision

- This will be the Group's final annual report entry; however, group activities will continue through existing close collaborations at MLW and KUHeS.
- To leverage the established data collection and collaborative networks to develop interventions to reduce the burden of early life infectious mortality in Malawi.



Vector Biology Group members, from left: Michelle Stanton, Kennedy Zembere, Group Head Chris Jones and Patrick Kalonde at a community engagement event to launch Maladrone in Kasungu. The Vector Biology Group's focus is on diseases transmitted by mosquitoes and tsetse flies. © MLW. Photographer: Rachel Mhango.

Vector Biology

I. Overview

The goal of the Vector Biology Group is to understand the biology of most important insect vectors in Malawi and inform effective vector control. The activities of the Group span both field and lab work. The focus of the group is on diseases transmitted by mosquitoes and tsetse flies. Our current research projects are particularly interested in how anthropogenic induced landscape changes affect vector ecology. We work closely with the entomology team at the Malaria Alert Centre (part of the Kamuzu University of Health Sciences, KUHeS) and are dedicated to supporting the next generation of Malawian entomologists.

Led by Dr Christopher Jones, and supported by Patience Korea (Admin), Vector Biology is made up of members at all academic levels, with skills ranging from field to the laboratory. Dr Jones is a founding member of Technical Vector Control Advisory Group to the Malawi Ministry of Health (MoH) (supported by the Partnership to Increase the Impact of Vector Control programme) and member of the National Malaria Control Programme sub-technical working group on Vector Control. The Group has strategic partnerships with the University of Glasgow, Illovo Sugar Ltd in Nchalo, and Lilongwe University of Agriculture and Natural Resources (LUANAR). Current Vector Biology research activities examine:

The impact of agricultural expansion on vector-borne disease in the Shire Valley as part of the NIHR-funded Global Health Research Group, Shire-Vec (<https://www.lstmed.ac.uk/shire-vec>)

- Develop empirical evidence on the interaction between irrigation and vector population dynamics as part of the Shire Valley Transformation project;

- Design practical and locally tailored vector control strategies that minimise the adverse effects of increased vector-host contact yet maintain the socio-economic benefits of agricultural development in Malawi;
- Improve the design of long-term mosquito and genomic surveillance schemes to provide real-time information for vector control programmes.



Kennedy Zembere demonstrating a mosquito light trap to communities in Kasungu. © MLW. Photographer: Rachel Mhango.

Using vector control to eliminate rHAT in Malawi as part of an MRC-funded project, STRESS (<https://www.lstmed.ac.uk/projects/strengthening-resilience-against-sleeping-sickness-in-malawi-stress>)

- Develop a tsetse sampling strategy to determine the population dynamics across the wildlife-agriculture interface in Vwaza Marsh Reserve;
- Determine where and when people are exposed to tsetse fly bites in the surrounding Vwaza communities;
- Characterise the dynamics and evolution of *Trypanosoma brucei rhodesiense* infection in the Vwaza Marsh Reserve through genomic surveillance;
- Design and implement a vector control strategy at the interface of the Vwaza Marsh Reserve.

II. Scientific achievements 2021

Key achievements by the Vector Biology Group in 2021 include:

Emerging agriculture and vector-borne disease

The Group received a ~£2.6m National Institute of Health Research (NIHR) grant to support a Global Health Research Group to understand how the development of a large irrigation scheme in the Shire Valley will impact the dynamics of vector-borne disease in the area. The project is a collaboration between MLW, KUHeS and the African Institute for Development Policy (AFIDEP) that brings together experts in entomology, schistosomiasis, ethnography, vector control and policy.



Steve Gowelo setting up an odour baited tsetse fly trap in Vwaza. © MLW.

Impact of the urban environment on vectors

- The Group has begun vector sampling as part of a new project led by the University of Stirling (UK) to look at the impact of plastics on human health by performing studies on the relationship between urban waste and mosquito vectors in Blantyre. (<https://www.stir.ac.uk/news/2020/november-2020/385m-stirling-led-study-to-tackle-impact-of-plastic-pollution-in-africa/>)

Using vector control to eliminate rHAT in Malawi

- In collaboration with the Malaria Alert Centre and University of Glasgow, the Vector Biology Group have secured a ~£1m grant from the Medical Research Council (MRC) UK to fund the *Strengthening Resilience against Sleeping Sickness in Malawi* (STRESS-MALAWI) project to tackle this zoonotic disease in the Vwaza Marsh Reserve.

Public engagement

- In November 2021, members of Vector Biology joined a series of events in Ndirande to promote the SPACES project's research objectives and make the community aware of the application of drones and plastics on public health. The project was highlighted on Zodiak Radio and in the *Malawi Times* newspaper.

III. Top publications since 2020

These are the most important papers published in scientific journals in 2021 by the Vector Biology Group (group member names in **bold**):

1. The application of drones for mosquito larval habitat identification in rural environments: a practical approach for malaria control? Stanton MC, Kalonde P, Zembere K, Hoek Spaans R, Jones CM. *Malar J.* 2021 May 31;20(1):244. doi: 10.1186/s12936-021-03759-2. PMID:34059053.
2. Microsatellites reveal that genetic mixing commonly occurs between invasive fall armyworm populations in Africa. Withers AJ, de Boer J, Chipabika G, Zhang L, Smith JA, Jones, CM, Wilson K. *Sci Rep* 2021 Oct 21;11(1):20757. doi: 10.1038/s41598-021-00298-3. PMID: 34675253.
3. The human-baited host decoy trap (HDT) is an efficient sampling device for exophagic malaria mosquitoes within irrigated lands in southern Malawi. Zembere K, Chirombo J, Nasoni P, McDermott D, Tchongwe-Divala L, Hawkes F, Jones CM. *BioRxiv* 2021. doi: <https://doi.org/10.1101/2021.08.26.457772>

IV. Translation

The Vector Biology Group is contributing to the wider discussions on the benefits of vector control in Malawi. This starts with an understanding of the biology and ecology of the vector. These include:

- Contributed to the Partnership for Increasing the Impact of Vector Control (PIIVEC)-led policy brief on trypanosomiasis and vector control in Malawi <https://www.piivec.org/resources/the-role-of-vector-control-in-preventing-and-responding-to-rhodesian-human-african>;
- Policy engagement strategy for the Technical Vector Control Advisory Group (TVACG). This document is a roadmap to operationalise the TVCAG activities.



Rhosheen Mthawanji sampling mosquito vectors as part of the SPACES project in Blantyre. © MLW. Photographer: Rhosheen Mthawanji.

V. Trainees

- **Lizzie Tchongwe Divala**, PhD fellow, University of Glasgow, Supervisors: M Marti/V Howick, Malawian, Active
- **Kennedy Zembere**, MSc fellow, 'The development and testing of substrates for evaluating insecticide efficacy for Indoor Residual Spraying (IRS)', Supervisor: C Jones, Malawian, Active

- **Clinton Nkholokosa**, MSc fellow, 'Measuring the impact of past, present and future environmental changes on schistosomiasis transmission in southern Malawi', Supervisor: M Stanton, Malawian, Active
- **Patrick Kalonde**, MSc fellow, 'Mapping plastic pollution and locations of waste piles using drone imagery and machine learning approaches', Supervisors: M Stanton/M Blinnikov, Malawian, Active
- **Rhosheen Mthawanji**, SPACES project, Supervisor: C Jones, Malawian, Active
- **Chifuniro Baluwa**, Pre-MSc intern, 'Dry season drivers of Malaria cases within the Kasungu district hospital catchment area', Supervisor: M Stanton, Malawian, Active
- **Remy Hoek Spaans**, MRC DTP, Vector control, 2018-2022, based at Liverpool School of Tropical Medicine, working on Illovo project, active

VI. Future vision

Shire-Vec to establish several long-term programmes to support the Group's activities:

1. Chikwawa Vector Surveillance Programme which will implement rolling monthly entomological surveys in the Shire Valley;
2. An entomological biobank held at MLW;
3. The Shire-Vec Training programme advertised in 2022 to fund at least x3 MSc and x3 PhD students at Malawian academic institutes in all aspects of vector biology.

The STRESS and Shire-Vec programmes will provide the foundation for the Group's growth and provide the space for junior Malawian entomologists to perform vector research. We also expect these projects to stimulate further collaboration with researchers within and outside of Malawi as part of funding applications.



Led by Jamie Rylance (4th from left), Dr Felix Limbani (not pictured) and Kate Mangulama (right), the Lung Health team focus on acute lung disease and how to improve the survival of hospitalised patients; developing better, more cost-effective treatments for chronic lung disease; and using controlled human infection models (CHIM) to identify new preventive treatments for respiratory infection. © MLW. Photographer: Hendrina Nkuta.

Lung Health

I. Overview

Lung problems can be acute, coming quickly, often due to infection, or chronic, slowly developing due to lung damage or long-term diseases. Our research examines:

- Monitoring and treatments – antibiotics, oxygen, intravenous fluids – for patients critically unwell with acute lung disease to improve clinical guidelines, reduce deaths and improve patient quality of care;
- Causes of and best treatments for chronic lung diseases, including asthma and post-tuberculous lung damage in Malawi;
- Prevention of lung infection through vaccines, using carefully controlled human infection to understand the immune system, testing promising immunisations so that they can be brought to market sooner, and at lower cost.

Led by Associate Professor Jamie Rylance (clinician) and Dr Felix Limbani (social scientist), we are a multidisciplinary group of researchers, nurses, doctors, study coordinators, administrators, clinical officers and field workers, who work closely with the Malawi Ministries of Health (MoH) and Education, (MoE) and within long-standing hospital partnerships in the Southern region.

The Lung Health team's current research focusses on:

Acute disease

Improving the survival of hospital in-patients by:

- Understanding how comorbid disease (multimorbidity) affects patients admitted to hospital, and how this can be identified through enhanced diagnostics to improve chronic outcomes (Multilink study);

- Defining cardiovascular responses to macrovascular and microvascular perfusion during early in hospital treatment of sepsis, and relate these to intravenous fluid treatment (CRISP study);
- Determining key quality indicators for critical illness to support quality improvement cycles for improved outcomes (Africa Research Collaboration in Sepsis across 10 countries);
- Testing novel therapies in critically unwell patients, eg randomised controlled trial of high-flow humidified oxygen for those with respiratory failure;
- Understanding in-patient COVID needs, including supporting the national strategies on treatment and oxygen.

Chronic disease

Developing better, more cost-effective, consistent treatments for chronic respiratory disease by:

- Describing the burden of asthma in school aged children, and implement schools-based interventions to improve disease recognition and control (ACACIA);
- Establishing the morbidity and mortality in COPD patients after completion of treatment, describe the longitudinal relationship of symptoms and lung function, and estimate the costs associated with healthcare seeking and treatment in this group.

Controlled Human Infection Models (CHIM)

Using CHIM to identify new preventative treatments for respiratory infection, specifically vaccination against *Streptococcus pneumoniae*. The success of this platform will allow other pathogens to be tested, including tuberculosis and salmonella.



Lung Health research nurse Beatrice Chinoko demonstrates the use of an improvised bottle spacer which improves inhaler efficiency at a community asthma awareness event. © MLW. Photographer: Pauline Mlogeni.

II. Scientific achievements 2021

Current grants exceeding £11m, of which £3m directly funds activity in Malawi. Key results include:

Acute disease

- Sepsis aetiology has been carefully described, with first descriptions in Africa of longer-term outcomes in both published manuscripts (*Lewis et al*), and international sepsis conferences in 2021 (*Rylance et al*). This shows considerable work is needed to maximise survival, focusing on late effects in addition to reducing pre-hospital delay.
- Cross-MLW work has enabled careful descriptions of COVID and its impact, with results feeding into national strategy (*Morton et al*).

Chronic disease

- Task shifting of asthma care to lay-workers can improve patient outcomes and school attendance in children. The potential to improve wellbeing, and educational attainment is important, and the intervention (evaluated in a randomised controlled trial) could be low cost compared with conventional medical follow-up. (*Rylance, S et al*).
- Work describing long term lung-function outcomes from tuberculosis shows that most individuals recover, mostly in the first year after treatment, but some have significant residual symptoms (*Nightingale et al*).
- A systematic review of post-tuberculosis lung disease and the potential for pulmonary rehabilitation in Malawi has resulted in a pilot trial of this therapy which has been refined with end-users for acceptability (*Bickton et al*).
- Evidence for early-life determination of lung function is growing. Our longitudinal cohort study showing that adult decline in lung function was no greater than expected due to aging, even in those highly exposed to household air pollution. (*Njoroge et al*) Birth cohort studies in collaboration with Ugandan partners will report this year.

Controlled Human Infection Models (CHIM)

- First-stage CHIM examining pneumococcal colonisation in healthy Malawians have concluded demonstrating feasibility and safety, and the model has been used to examine immunological responses to pneumococcal vaccination (*Morton et al*) We can evaluate vaccine candidates in fewer people than a phase 3 trial can.

Public engagement

- Using results from the successful randomised controlled trial of lay-worker delivered asthma treatment, developed a structured programme of support to over 700 people in communities and 13 health centres, based around recognition and management of asthma emergencies.
- Media outreach on overall management of asthma, themed 'No more Asthma Death' (*Times TV*).

III. Top 5 publications since 2020

These are the most important of the 27 papers published in scientific journals in 2021 by the Lung Health Group (group member names in **bold**):

1. A longitudinal observational study of aetiology and long-term outcomes of sepsis in Malawi revealing the key role of disseminated tuberculosis. Lewis JM, Mphasa M, **Keyala L**, Banda R, **Smith EL**, Duggan J, Brooks T, Catton M, Mallewa J, Katha G, **Gordon SB**, Faragher B, Gordon MA, **Rylance J**, Feasey NA. *Clin Infect Dis*. 2021 Aug 18;ciab710. doi: 10.1093/cid/ciab710. PMID: 34407175.
2. Distinct clinical and immunological profiles of patients with evidence of SARS-CoV-2 infection in sub-Saharan Africa. **Morton B**, Barnes KG, Anscombe C, Jere K, Matambo P, Mandolo J, Kamng'ona R, Brown C, Nyirenda J, Phiri T, **Banda NP**, Van Der Veer C, Mndolo KS, Mponda K, **Rylance J**, Phiri C, Mallewa J, Nyirenda M, Katha G, Kambiya P, Jafali J, Mwandumba HC, **Gordon SB**, Blantyre C-C, Cornick J, Jambo KC. *Nat Commun*. 2021 Jun 11;12(1):3554. doi: 10.1038/s41467-021-23267-w. PMID: 34117221.
3. A feasibility study of controlled human infection with *Streptococcus pneumoniae* in Malawi. **Morton B**, Burr S, Chikaonda T, Nsomba E, Manda-Taylor L, Henrion MYR, **Banda NP**, **Rylance J**, Ferreira DM, Jambo K, **Gordon SB**, consortium M. *EBioMedicine*. 2021 Oct;72:103579. doi: 10.1016/j.ebiom.2021.103579. PMID: 34571365.
4. Respiratory symptoms and lung function in patients treated for pulmonary tuberculosis in Malawi: a prospective cohort study. **Nightingale R**, **Chinoko B**, Lesosky M, **Rylance SJ**, **Mnesa B**, **Banda NPK**, Joeke E, Squire SB, Mortimer K, **Meghji J**, **Rylance J**. *Thorax*. 2021 Dec 22; thoraxjnl-2021-217190. doi: 10.1136/thoraxjnl-2021-217190. PMID: 34937802.



A woman donning a T-shirt with asthma information during a community awareness meeting in Mpemba, Blantyre. © MLW. Photographer: Pauline Mlogeni.

5. An enhanced care package to improve asthma management in Malawian children: a randomised controlled trial. **Rylance S**, **Chinoko B**, **Mnesa B**, Jewell C, Grigg J, Mortimer K. *Thorax*. 2021 May;76(5):434-440. doi: 10.1136/thoraxjnl-2020-216065. PMID: 33479040.

IV. Translation

The Lung Health Group's contributions to translating science into public benefit include:

- Cross-theme work on COVID clinical descriptions paired with sequencing data to support the national response;
- Working with the Health Economics and Policy unit to deliver a systematic review of tools for capturing quality of care (Susan Banda). This supported the Quality Care Division activities at the Malawi MoH;
- Supporting asthma care delivery across the city using the results of our recent RCT (*Rylance S, et al*), leading to decreased referrals to hospital, advocacy for universal availability of life-saving inhaler therapy, and the formation of the Asthma Association of Malawi to support grass-roots work in the area. All led by nurse specialist Beatrice Chinoko.

V. Trainees in 2021

- **Sepedeeh Saleh**, PhD fellow, 'Air pollution in Mpemba, Malawi: A multidisciplinary exploration of the burden and possible solutions', Supervisors: Mortimer/J Rylance/Chinouya/Kumwenda, British, Active
- **Martin Njoroge**, PhD fellow, 'Assessing the economic burden of non-communicable lung disease and modelling the impact of patient-oriented interventions amongst adults in Malawi', Supervisors: Devereux/Obasi/Nielsen/Rylance, Kenyan, Active
- **Fanuel Bickton**, MSc fellow, 'Feasibility and acceptability of a pulmonary rehabilitation programme for adults with functionally limiting chronic respiratory disease at Queen Elizabeth Central Hospital, Blantyre, Malawi: a mixed-methods single-arm interventional prospective cohort study', Supervisor, J Rylance, Malawian, Active
- **Elizabeth Mkutumula**, ACACIA study, Supervisor: S Rylance, Malawian, Active

VI. Future vision

Lung Health Group future research work will aim to:

- Expand the use of our High Dependency Unit as a place for phase 1/2 studies;
- Increased use of informatics in hospitals to understand patient journeys and outcomes in geospatial terms between primary and secondary care;
- Describe multimorbidity in sub-Saharan Africa, redefining a patient-centric framework, and trial of new pathways for care delivery between secondary and primary care;
- Build on South-South collaborations in current grants (Tanzania, Uganda) to strengthen pan-African networks.



The GEARM team use their expertise in microbiology, 'omics, bioinformatics, genomics and statistics to understand the genetic epidemiology of key bacteria important to human health in Malawi. Front row, from left: Alex Shabani. GEARM Head Jen Cornick and Deputy Head James Jafali. Back row, from left: Victor Maiden. Irene Sheha, Priscilla Salleh and Gareth Lipunga. © MLW. Photographer: Zuze Matoliro.

Genomic Epidemiology & Antimicrobial Resistant Microbes (GEARM)

I. Overview

The Genomic Epidemiology & Antimicrobial Resistant Microbes (GEARM) Group uses basic microbiology and 'omics technologies to understand the genetic epidemiology of key bacteria important to human health in Malawi and globally. More specifically it is interested in how vaccine and antibiotic-induced selective pressures impact bacterial population structure. During the onset of the COVID pandemic, the Group redirected their efforts to establish the first COVID-19 molecular diagnostic and sequencing laboratory in Malawi.

Led by microbiologist and bacterial genome specialist Dr Jen Cornick, the Group is made up of two post-doctoral scientists with multiple areas of expertise, including bioinformatics, genomics, microbiology and statistics, a study co-ordinator and laboratory scientist.

Looking forward, in collaboration with the lead molecular microbiologist Dr Catherine Anscombe and the Virology Group, GEARM will establish an Illumina sequencing resource in the CREATOR building at MLW, to sequence pathogens of importance to human health locally, facilitating investigation of outbreaks in real time.

The GEARM Group currently seeks to understand:

1. How vaccines and antibiotic-induced selective pressures shape the population structure of key pathogenic bacteria colonising the gut and nasopharynx;
2. The emergence and transmission of antibiotic-resistant hospital-acquired infections in Malawian hospitals; and
3. How we can build laboratory capacity to improve diagnosis and surveillance of infectious diseases in Malawi.

To find out, GEARM is currently focusing on:

Vaccines and Antibiotic Selective Pressures

- Determining if mass drug administration programmes drive the emergence of resistance in key pathogenic bacteria colonising the nasopharynx (*Streptococcus pneumoniae*) and gut (*E. coli*);
- Evaluating the impact of malaria and pneumococcal vaccines on antibiotic consumption in children and how this relates to carriage of resistant bacteria in the nasopharynx and gut;
- Establishing a surveillance study to determine the incidence of Shigella in Malawi, this will provide a platform on which to assess the impact of future control measures against this important cause of diarrhoeal death.

Antibiotic Resistant Hospital Acquired Infections

- Defining the evolution of MRSA isolates from invasive infection at Queen Elizabeth Central Hospital (QECH) over the last two decades and positioning them in a global context;
- Ascertaining what drives antibiotic resistant *Klebsiella pneumoniae* outbreaks at QECH.

Improving Laboratory Capacity

- Designing and implementing laboratory interventions to improve the diagnosis of brain infections in Malawi, Brazil and India.

II. Scientific achievements 2021

The Group has remained very productive and published 17 papers in 2020-2021. Key results and activities include:



GEARM Group Lab Researcher Victor Maiden working on blood culture samples, Blantyre, Malawi. © MLW. Photographer: Zuze Matoliro.

Antibiotics for Children with Severe Diarrhoea (ABCD) Study

- Publishing the results of the ABCD clinical trial. The Group reported that the addition of azithromycin to standard WHO case management for acute watery diarrhoea does not drive the emergence of antibiotic resistance in key pathogenic bacteria colonising the gut and nasopharynx within the study participants or their household contacts.

Shigella Genomic Epidemiology

- Characterising Shigella isolates from Malawi using whole genome sequence analysis for the first time. The Group detected a high proportion of MDR Shigella, due to acquisition of fluoroquinolone resistance elements and multi-drug resistant plasmids.

Outbreak Investigation on a Neonatal Ward

- Reporting that a spike in bloodstream infections on a neonatal ward in Malawi was driven by the emergence of a multi-drug resistant clone, untreatable with locally available antibiotics.

COVID-19

- Establishing the COVID-19 diagnostic and sequencing lab at MLW, the first to offer molecular testing for COVID-19 in Malawi. The lab supports MLW based research projects and the Ministry of Health by providing molecular diagnostics and genomic surveillance for SARS-CoV-2.

Brain infections Diagnosis

- Completing an observational phase, in four district hospitals, monitoring clinical and microbiological pathways to diagnosis of brain infections. The findings were reported to key stakeholders and the Malawi Ministry of Health (MoH) in December 2021.

Engagement with policymakers

- Dr Cornick is a member of MoH's Antimicrobial Resistance Technical working group;
- Working with MoH to contribute MLW blood culture data to the WHO GLASS system;
- Dr Cornick is a member MoH COVID Laboratory Working Group.

III. Top 5 publications since 2020

The five most significant papers from the group in 2021 are (group member names in **bold**):

1. Distinct clinical and immunological profiles of patients with evidence of SARS-CoV-2 infection in sub-Saharan Africa. Morton B, Barnes KG, Anscombe C, Jere K, Matambo P, Mandolo J, Kamng'ona R, Brown C, Nyirenda J, Phiri T, Banda NP, Van Der Veer C, Mndolo KS, Mponda K, Rylance J, Phiri C, Mallewa J, Nyirenda M, Katha G, Kambiya P, **Jafari J**, Mwandumba HC, Gordon SB; Blantyre COVID-19 Consortium, **Cornick J**, Jambo KC. *Nat Commun*. 2021 Jun 11;12(1):3554. [https://doi: 10.1038/s41467-021-23267-w](https://doi.org/10.1038/s41467-021-23267-w). PMID:34117221.
2. Effect of 3 days of oral azithromycin on young children with acute diarrhea in low-resource settings: a randomized clinical trial. Ahmed T, Chisti MJ, Rahman MW, Alam T, Ahmed D, Parvin I, Kabir MF, Sazawal S, Dhingra P, Dutta A, Deb S, Chouhan A, Sharma AK, Jaiswal VK, Dhingra U, Walson JL, Singa BO, Pavlinac PB, McGrath CJ, Nyabinda C, Deichsel EL, Anyango M, Kariuki KM, Rwigy D, Tornberg-Belanger SN, Kotloff KL, Sow SO, Tapia MD, Haidara FC, Mehta A, Coulibaly F, Badji H, Permala-Booth J, Tennant SM, Malle D, Bar-Zeev N, Dube Q, Freyne B, Cunliffe N, Ndeketa L, Witte D, Ndamala C, **Cornick J**,et al. *JAMA Netw Open*. 2021 Dec 1;4(12):e2136726. doi:10.1001/jamanetworkopen.2021.36726. PMID 34913980.
3. Genomic investigation of a suspected *Klebsiella pneumoniae* outbreak in a neonatal care unit in sub-Saharan Africa. **Cornick J**, Musicha P, Peno C, Seager E, Tam P-Y I, **Bilima S**, Bennett A, Kennedy N, Feasey N, Heinz E, Cain AK. *Microb Genom*. 2021 Nov;7(11):000703. doi:10.1099/mgen.0.000703. PMID:34793293.
4. Whole genome sequence analysis of *Shigella* from Malawi identifies fluoroquinolone resistance. Stenhouse GE, Jere KC, Peno C, Bengtsson RJ, Chinyama E, Mandolo J, Cain A, Iturriza-Gómara M, Bar-Zeev N, Cunliffe NA, **Cornick J**, Baker KS. *Microb Genom*. 2021 May;7(5):000532. doi:10.1099/mgen.0.000532. PMID: 33945457.

5. Whole genome comparative analysis of *Streptococcus pneumoniae* serotype 1 isolates causing invasive and non-invasive infections among children under 5 years in Casablanca, Morocco. Nzoyikorera N, Diawara I, Fresia P, Maaloum F, Katfy K, Nayme K, Maaloum M, **Cornick J**, Chaguza C, Timinouni M, Belabess H, Zerouali K, Elmdaghri N. *BMC Genomics*. 2021 Jan 7;22(1):39. doi: 10.1186/s12864-020-07316-0. PMID: 33413118.

IV. Translation

While GEARM primarily conducts basic science, its activities have had translational impact, including:

1. Work to establish the environmental reservoirs of hospital acquired infections will directly impact infection control and prevention policies within QECH;
2. Established COVID-19 diagnostic and sequencing lab, which produces data that are reported directly to the Malawi Ministry of Health and inform the national COVID-19 response;
3. The GEARM-led Brain Infections Global (BIGlobal) team are designing country specific interventions packages to improve the diagnosis and management of brain infections.



GEARM Group trainees Dr Gareth Lipunga (left) and Dr Oliver Pearse, © MLW. Photographer: Zuse Matoliro.

V. Trainees in 2021

- **Dr Oliver Pearse**, PhD fellow, 'Modelling transmission of multi-drug resistant *Klebsiella pneumoniae* amongst inpatient neonates, accounting for within-species diversity and bacterial quantity', Supervisor: N Feasey/J Cornick, British, Active
- **Dr Gareth Lipunga**, Pre-MSc & BIGlobal study co-ordinator, Supervisor: J Cornick, Malawian, Active

VI. Future Vision

- Employ improved hospital diagnostics and local sequencing capacity to track disease outbreaks in real time;
- Take a one-health approach to gain a holistic view of the selective pressures shaping the population structures and transmission of key bacterial pathogens in Malawi; and
- Ascertain the incidence of *Shigella* in Malawi and partner countries in South America and Asia to pave the way for a future vaccine trial.



Biostatistics Associate Research Group Head Marc Henrion (*left*) and Deputy Head James Chirombo (*right*) with team members Vitumbiko Chirwa (holding a laptop with UK-based Jessie Khaki connected remotely) and Susanne Barnaba (holding Lilongwe-based Ruth Vellemu, also joining virtually). © MLW. Photographer: Zuze Matoliro.

Biostatistics Associate Research Group

I. Overview

The Biostatistics Associate Research Group conducts applied biostatistical research, trains researchers in statistical methods and provides MLW research groups with statistical advice.

Dr Marc Henrion (Head) and Dr James Chirombo (Deputy Head) lead a talented team of Malawian biostatisticians who engage in applied statistical methodological research, extending existing or developing new methodologies to answer relevant biomedical research questions. Besides training biostatisticians at MLW, the Group engages with the Malawian statistics community, and works to develop the next generation of Malawian biostatisticians.

With an extensive collaborative and support reach, the Group provided statistical support to 108 projects from groups based at MLW, Kamuzu University of Health Sciences (KUHeS), LSTM and University of Liverpool in 2021. The Group works with other statistical teams in the Wellcome Africa and Asia Programmes (AAP), organising monthly teleconferences.

The Biostatistics team's current activities focus on:

Geostatistical modelling

- Methods for increasing the spatial resolution in the analysis of geo-referenced incidence and prevalence data;
- Developing methodology for sparsely sampled point pattern data;
- Models for spatio-temporal-genomic analyses of pathogen strains.

Data synthesis through probability models

- Combining census, surveillance, healthcare utilisation and serology data through spatio-temporal models;

- Combining climate, epidemiological and demographic data to study the impact of climate change on health;
- Integrative models for multi-platform, multi-condition transcriptomic data.

Climate change impact on health

- Developing statistical methodology to study the impact of climate change on health, with a focus on malaria in Malawi.

Machine learning for public health research

- Machine learning tools to identify a gene signature predictive of viral or bacterial source of infection;
- Investigating the use of machine learning for electronic medical records in Malawi.

Principled inference for applied epidemiology

- Inference tools for flexible regression models (generalised additive models, fractional polynomials, among others) with an application to serology data for vaccine development;
- *bootComb* R package for deriving confidence intervals for combinations of independently estimated parameters while correctly propagating the uncertainty from each estimate.



Group photo after a workshop on the public data landscape with Cooper / Smith data science consultancy and the Ministry of Health (MoH), facilitated by the Biostatistics Associate Research Group and the MLW Policy Unit. © MLW 2021. Photographer: Pauline Mlogeni.

II. Scientific achievements 2021

The Biostatistics Associate Research Group continues to be productive, with 17 papers published in 2021.

Geostatistical modelling

- J. Khaki, PhD student at Lancaster University, is investigating methods to analyse sparse, spatio-temporal point pattern data on typhoid incident cases.
- D. Kalonga, MSc intern, is investigating the spatio-temporal distribution of different sub-lineages of typhoid incident cases.
- V. Chirwa is working on a model to predict air quality measurements across Blantyre (with the ultimate aim to investigate the effect of poor air quality on incident and prevalent TB).

Data synthesis

- M. Henrion developed a Bayesian bivariate mixed-effects model for an individual-level patient data meta-analysis to identify optimal diagnostic thresholds and estimate sensitivities and specificities of 4 biomarkers for liver disease (manuscript in preparation).
- M. Henrion leads the statistical analysis for the first human challenge study in sub-Saharan Africa (<https://doi.org/10.1016/j.ebiom.2021.103579>). Data from this programme will be synthesised with EHPC programme data from Liverpool.

Climate change impact on health

- J. Chirombo facilitated training to build national capacity on integrating climate and weather information with health data in health surveillance and early warning systems.
- J. Chirombo, together with co-PI M. Stanton, secured an institutional translational project award on “Developing a digital platform for sub-district level malaria burden stratification mapping using routine health facility case data – guiding the national transition to targeted malaria control”.

Machine learning

- Ongoing work to identify a gene signature differentiating between bacterial, viral and parasite infections. Currently preparing a bid to translate this research into practice.

Principled inference for applied epidemiology

- Paper describing the *bootComb* R package (<https://cran.r-project.org/package=bootComb>; <https://doi.org/10.1093/ije/dyab049>) published and extension for dependent parameters (<https://arxiv.org/abs/2202.04519>).

SARS-CoV-2

- Contributed to SARS-CoV-2 research in Malawi and abroad, showing the effect of the SARS-CoV-2 pandemic on tuberculosis notification rates (<https://doi.org/10.3201/eid2707.210557>), describing the neurological manifestations of SARS-CoV-2 on hospitalised children and adolescents in the UK ([https://doi.org/10.1016/s2352-4642\(21\)00193-0](https://doi.org/10.1016/s2352-4642(21)00193-0)) and estimating the seroprevalence of SARS-CoV-2 in Malawian blood donors (<https://doi.org/10.1186/s12916-021-02187-y>).

Teaching

- *SSACAB-II*, a biostatistics capacity building consortium, of which the Group is a collaborator, secured funding for the next 4 years;
- Annual Statistics & R short course to MLW and KUHeS staff and students;
- Contributed to and taught remotely on the LSTM MRes Global Health Programme, module DLTROP204;
- Introductory Statistics module, Clinical Research Induction Training (CRIT), MLW.
- Statistics module, Clinical Research Methods (CRM01), KUHeS.

Public engagement

- Regular contributor to media reports and science articles.
- Active participant in MLW internal communications (website, newsletter).

III. Top 5 publications since 2020

These are the most important of the 17 papers published in scientific journals in 2021 by the Group (group members in **bold**):

1. SARS-CoV-2 exposure in Malawian blood donors: an analysis of seroprevalence and variant dynamics between January 2020 and July 2021. Mandolo J, Msefula J, **Henrion MYR**, Brown C, Moyo B, Samon A, Moyo-Gwete T, Makhado Z, Ayres F, Motlou T, Mzindle N, Kalata N, Muula AS, Kwatra G, Nsamala N, Likaka A, Mfune T, Moore PL, Mbaya B, French N, Heyderman RS, Swarthout T, Jambo KC. *BMC Med*. 2021 Dec;19(1):303. PMID: 34794434; PMCID: PMC8601780.
2. Incidence of HIV-positive admission and inpatient mortality in Malawi (2012–2019). Burke RM, **Henrion MYR**, Mallewa J, Masamba L, Kalua T, Khundi M, Gupta-Wright A, Rylance J, Gordon SB, Masesa C, Corbett EL, Mwandumba HC, Macpherson P. *AIDS*. 2021 Nov 1;35(13):2191–2199. PMID: 34172671; PMCID: PMC7611991.
3. A feasibility study of controlled human infection with *Streptococcus pneumoniae* in Malawi. Morton B, Burr S, Chikaonda T, Nsomba E, Manda-Taylor L, **Henrion MYR**, Banda NP, Rylance J, Ferreira DM, Jambo K, Gordon SB. *eBioMedicine*. 2021 Oct;72:103579. PMID: 34571365; PMCID: PMC8479630.

4. Prevalence and correlates of herbal medicine use among Anti-Retroviral Therapy (ART) clients at Queen Elizabeth Central Hospital (QECH): A cross-sectional study. Mbali H, **Khaki-Sithole JJ**, Nyondo-Mipando L. *Mal Med J*. 2021 Sep;33(3):153-158. doi: 10.4314/mmj.v33i3.2
5. bootComb—an R package to derive confidence intervals for combinations of independent parameter estimates. **Henrion, M.Y.R.** *International Journal of Epidemiology*. 2021 Aug;50(4): 1071-1076. doi: 10.1093/ije/dyab049. PMCID: PMC8407867.



James Chirombo delivers a session at a statistics workshop organised by the Biostatistics Research Group. © MLW 2020. Photographer: Marc Henrion.

IV. Translation

Collaborating closely with other groups, Biostatistics' translational impact on public health since January 2021 includes:

- Open-source software package *bootComb* (<https://cran.r-project.org/package=bootComb>) for deriving confidence intervals of combinations of independently estimated parameters;
- Dashboards for the HDRU and the Paediatrics Ward at Queen Elizabeth Central Hospital;
- Contributed to COVID-19 surveillance, feeding into MoH data pool and monitoring of the local spread of the disease, sero-prevalence and impact on public health outcomes;
- Biostatistics capacity building through lecturing at KUHeS, University of Malawi (UNIMA) and mentoring young Malawian statisticians;
- Invited by WHO Malawi office and MoH to deliver training at MoH on integrating climate information with health data and early warning systems.

V. Trainees active in 2021

- **J. Khaki-Sithole**, PhD fellow, ‘Spatiotemporal evidence synthesis for typhoidal and non-typhoidal *Salmonella* infection in Ndirande, Blantyre’, Supervisors: E Giorgi/M Henrion/M Gordon, Malawian, Active
- **V. Chirwa**, Pre-PhD intern, Supervisors: M Henrion/P MacPherson, Malawian, Active
- **Don Kalonga**, MSc student, Supervisor: M Henrion, Malawian, Active
- **Ruth Vellemu**, MSc student, Supervisor: J Chirombo, Malawian, Active
- **Susanne Barnaba**, MSc student, Supervisor M Henrion, Malawian, Active

VI. Future vision

- Become a full Research Group, developing its research agenda with a focus on statistical methods to study the impact of climate change on health, principled statistical inference for flexible regression models and software development;
- Group head and deputy to secure fellowships;
- Split the Statistical Support Unit and the Biostatistics Research Group into separate entities with their own leads;
- Strengthen links and collaborations with national partners such as Cooper/Smith and the Malawi Ministry of Health through participation in relevant technical working groups.



Group Lead Eleanor MacPherson (3rd from left) and her Medicine and Society draw on social theory and empirical work to understand medicine use practices, particularly the social and behavioural drivers of antimicrobial resistance (AMR). © MLW. Photographer: Hendrina Nkuta.

Medicine and Society

I. Overview

The ways that medicines are used in society are shaped by a wide range of factors. They often take on different meanings and are used in ways that do not always reflect clinical indications. Providing insights into the ways people use and make sense of medicines in their lives is important for addressing a range of health challenges including antimicrobial resistance.

The Medicines and Society Associate Group draws on social theory and empirical work to understand medicine use practices, particularly around antimicrobials both within households and clinical settings. By understanding how antibiotics are used, and what shapes these use practices, we can build more responsive policies to address antimicrobial resistance. In the past year, we have been using our extensive knowledge of antibiotic use practices and our strong networks with policy makers to deliver the AMR Responsive Dialogues project. This study uses participatory approaches to bring together affected communities and key stakeholders with the aim of sharing information to galvanise action and create local solutions to reduce the burden of AMR.

The Group is led by Dr Eleanor MacPherson, a social scientist with a background in gender and public health, supported by Deputy Head Mackwellings Phiri, a social scientist with an interest in masculinity and bioethics, and administrator Kate Mangulama. Other Medicine and Society team members include John Mankhomwa, Raymond Pongonlani and Helen Mangochi.

An inclusive collaboration with an interdisciplinary approach, the Group operate in Queen Elizabeth Central Hospital (QECH), Ndirande and Chileka. Using qualitative, participatory and survey methods, they work closely with academics and groups from a range of disciplines, including clinical, microbiology and environmental sciences.

Training and capacity strengthening are at the centre of Medicine and Society Group's work. The Group aim to develop networks with social scientists working in Malawi and collaborate with regional networks. Current research activities investigate:

The social and behavioural drivers of antimicrobial resistance (AMR)

- Use social science methodologies to understand the types of antibiotics being used and in what quantities in households and clinical settings;
- Draw on empirical work and social theory to make visible the ways broader systems and structures drive antibiotic use.

The meaning of care and how it relates to antimicrobial use

- Use ethnographic research in households and clinical setting to understand the relationship between care and antimicrobials.

Using a One Health approach to address the drivers of AMR

- Draw on participatory methods to develop structural interventions to reduce antibiotic use that respond to peoples' lived realities.



Woman holding antibiotics, Chileka, Malawi. © MLW. Photographer: Thoko Chikondi.

II. Scientific achievements 2021

The Medicine and Society Associate Group continues to be productive, with 6 papers published in 2021. Key results include:

Care and antimicrobial use

- Globally, antimicrobial resistance has often been framed as either a problem of access or excess, with stewardship interventions and overall reductions the dominant intervention to 'rationalise' use. Insufficient attention has been paid to care relations beyond the binary of 'too many' or 'too few' – particularly in low-income contexts – and how these relations shape, and are shaped by, antibiotic prescribing. Addressing this gap, our ethnographic work provides an in-depth examination of the practices that comprise care in rural Chikwawa. In this context, we found that care was centred around provision of an antimicrobial. Amid chronic lack of essential medicines and other resources, clinic interactions were tightly scripted, providing patients little time to question or negotiate their treatment. Based on our empirical work we developed the concept of 'antibiotic vulnerabilities' to reveal multiple ways in which provision of antimicrobials in rural Malawi impacts care in conditions of extreme scarcity (MacPherson EE, et al., *Glob Public Health* .2021).

One Health approach and drivers of AMR

- Drawing on qualitative interviews and surveys we found an intensive use of antibiotics in urban poultry farmers in Blantyre, Malawi. Use was driven by economic need of farmers to realise profits (paper in draft)

Infection Prevention and Control practices in a neo-natal intensive care unit

This ethnographic study was conducted to understand Infection Prevention and Control practices, focussing on hand hygiene on a neonatal referral unit in Blantyre, Malawi following a series of outbreaks of neonatal sepsis associated with antimicrobial resistant *K. pneumoniae*.

Public engagement

- Supported the development of materials in English and Chichewa providing information on antibiotics and resistance in Malawi and attended the World Antibiotic Awareness week in Lilongwe (November 2021).
- Delivering the Responsive Dialogues project, which is funded by Wellcome and working in collaboration with the AMR Unit at the Ministry of Health to improve public understanding and co-create interventions to address AMR.

III. Top 5 publications since 2020

These are the most important of the 6 papers published in scientific journals in 2021 by the Medicine and Society Associate Group (group member names in **bold**):

1. Antibiotic arrivals in Africa: Case study of yaws and syphilis in Uganda, Malawi and Zimbabwe. Palanco Lopez P, Manyau S, Dixon J, **MacPherson E**, Nayiga S, Manton J, Kirchhelle C, Chandler CIR. *Medicine Anthropology Theory*. 2021 (in press).
2. Understanding antimicrobial resistance through the lens of antibiotic vulnerabilities in primary health care in rural Malawi. **MacPherson EE**, Reynolds J, Sanudi E, Nkaombe A, **Phiri C**, **Mankhomwa J**, Dixon J, Chandler CIR. (2021), *Glob Public Health*. 2021 Dec 21:1-17. <https://doi.org/10.1080/17441692.2021.2015615>. PMID: 34932915.

3. A Qualitative Study exploring health workers and patient caregivers' hand hygiene practices in a neonatal unit in Blantyre, Malawi, implications for controlling outbreaks of drug resistant infections. **Mangochi H**, Tolhurst R, Simpson V, Kawaza K, Chidziwisano K, Morse T, Feasey N, **MacPherson EE**. *SocArXiv* Oct 2021. doi: [10.31235/osf.io/56swt](https://doi.org/10.31235/osf.io/56swt).
4. Antibiotic Stories: A Mixed-Methods, Multi-Country Analysis of Household Antibiotic use in Malawi, Uganda and Zimbabwe. Dixon J, **MacPherson E**, Nayiga S, Manyau S, Nabirye C, Kayendeke M, Sanudi E, Nkoambe A, Mareke P, Sithole K, de Lima Hutchison C, Bradley J, Yeung S, Ferrand R, Lal S, Roberts C, Green E, Denyer Willis L, Staedke S, Chandler CIR. *BMJ Glob Health*. 2021 Nov;6(11):e006920. doi:10.1136/bmjgh-2021-006920. PMID: 34836911.
5. Improving pathways to care through interventions co-created with communities: a qualitative investigation of men's barriers to tuberculosis care-seeking in an informal settlement in Blantyre, Malawi. **Phiri M**, Makepeace E, Nyali M, Kumwenda M, Corbett EL, Fielding K, Choko CT, MacPherson P, **MacPherson EE**. *BMJ Open* 2021 Jun 30;11(6):e044944. <https://doi.org/10.1136/bmjopen-2020-044944>. PMID: 34193484.



Dr Watipaso Kasambara, AMR coordinator, Malawi Ministry of Health, co-leading a stakeholder engagement workshop. © MLW. Photographer: Eleanor MacPherson.

IV. Translation

The Medicine and Society Group's research and activities have generated these impacts to address critical health needs in Malawi:

- Awarded a transitional award to explore preferred hand hygiene products at Queen Elizabeth Central Hospital;
- The Male partner-assisted contact tracing for HIV and tuberculosis in Malawi: an adaptive multi- arm multi-stage randomised trial (mPATCH-TB) study generated findings on target interventions that may improve men's pathways to care;
- Developed strong relationships between the AMR Unit at the Malawi Ministry of Health providing funding and support for Antibiotic Awareness Week activities in 2021

V. Trainees

- **Mackwellings Phiri**, MPH Global Health, Supervisor: E MacPherson, Malawian, Active
- **Lusungu Kayira**, MPH Global Health, Kamuzu University of Health Sciences, Supervisor: E MacPherson, Malawian, Active

VI. Future vision

- Continue to strengthen capacity and support junior research team to publish academic papers and secure funding for further educational opportunities;
- Further develop our international network with social scientist across Malawi and Southern Africa;
- Deliver cutting-edge social research.



Led by Dr Moses Kumwenda (3rd left), the Gender in Health team of social scientists uses applied social science research methods to explore gender's impact on health and generate evidence that improves health-seeking behaviours, promotes better community interaction with health systems, and enhances effective implementation of new health technologies in resource-constrained settings. © MLW. Photographer: Pauline Mlogeni.

Gender in Health

I. Overview

The Gender in Health Associate Research Group examines the role of gender in influencing women and men's health care experience, attitudes towards illness, and how they seek care when ill. The Group's primary goal is to ensure that this knowledge informs the development of health care delivery programmes that respond to the gender dimensions of health to improved outcomes for all.

Led by Dr Moses Kumwenda, a medical anthropologist and an EDCTP career development fellow, the Group comprise a team of social scientists who employ applied social science research methods to explore gender's impact on health and generate evidence that improves health-seeking behaviour, promotes better community interaction with health systems and enhances effective implementation and application of novel health technologies in resource-constrained settings.

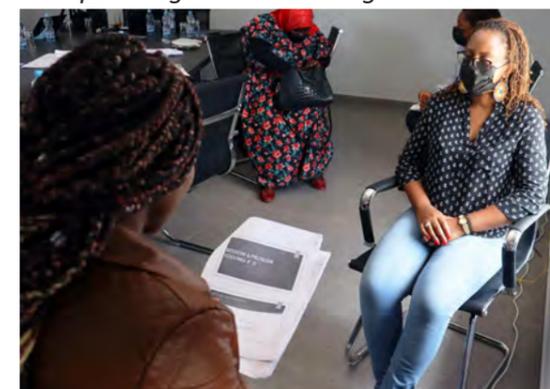
The Group works closely with MLW's Medicines in Society and Community Engagement and Bioethics Groups, which operate under the umbrella of the Social Science Theme, as well as the Public Health Group and the Maternal and Fetal Health Group. At Kamuzu University of Health Sciences (KUHeS), the Group collaborates with the Helse Nord Tuberculosis Research Team and the Mental Health Department. They have also established links with health facilities in Blantyre and Chikwa Districts and departments within the Ministry of Health. Their regional and international links allow them to contribute to global policies.

To advance knowledge, improve ethical conduct of health research in the global south and to contribute to training social scientist, the Group's current work focuses on:

The impact of home-based diagnostics and self-care on men's engagement with health and prevention.

- Understand the gender, social, legal, human rights and public health dimensions of introducing self-care and home-based diagnostic technologies:
 - o Piloting an Intervention for Malawian Pregnant Women with HIV to Improve Depression, mViral Suppression and Engagement of Partners in HIV Self-Testing;
 - o Values & Preferences For Covid-19 Self-Testing In Low- And Middle-Income Countries: A Qualitative Study in Malawi;
 - o An evaluation of the feasibility of self- sampling for COVID-19 antigen tests among patients and health care workers in Malawi and Zimbabwe.

Incorporating intersectional gender lens in research on infectious diseases of poverty



A practice session on mental health during a workshop for the TENDAI Study that is being implemented in Malawi and Zimbabwe. © MLW. Photographer: Pauline Mlogeni.

- Understand the theoretical concept of intersectional gender lens and to explore its incorporation into medical research practice.
 - o An Assessment of Gender and Intersectionality in Exposure to Mosquito Bites, Care Seeking and Treatment Pathways for Malaria in Kenya and Malawi.

Developing effective strategies to engage men in healthcare research and interventions

- Explore key social determinants of men's engagement in health research and health interventions and determine the impact of gender on engagement with new biomedical interventions;
- Assess and address masculinity and gender issues and their impact on access to and use of healthcare, including developing interventions to improve men's recognition of and response to severe illness:
 - o Developing "U=U" communication messages in Malawi: Establishing evidence on feasibility and acceptability;
 - o Malawi National Systematic Evidence Review: Getting To The Heart Of Stigma.

II. Scientific achievements 2021

The Gender and Health Associate Group continue to be very productive, with 10 papers published in 2021. Key results include:

The impact of home-based diagnostics and self-care on men's engagement with health and prevention

- We explored the feasibility and acceptability of providing oral fluid-based peer-led HIVST to FSW to inform tailored HIVST delivery approaches. FSW spoke positively about peer-led HIVST and it was preferred to facility-based HIV testing. FSW highlighted greater control of their testing experience and freedom from discriminatory attitudes frequently experienced in public facilities;



A couple during a counselling and testing of HIV session supported by MLW's Gender in Health team. © MLW. Photographer: Pauline Mlogeni.

- We investigated how age is enacted socially and its implications on the introduction of HIV self-testing as part of strategies for engaging midlife-older adults in HIV testing, prevention and care. We reported that midlife-older adults (30–74 years of age) associated their age with respectability and identified HIV as “a disease of youth”. HIV testing was felt to be stigmatizing, challenging age norms, threatening social status, and implying “lack of wisdom”. These norms drove self-testing preferences at home or other locations deemed age and gender appropriate.

Developing effective strategies to engage communities (men and women) in healthcare research and interventions

- We created an ethnography of a rural Malawian village, aimed to understand air pollution within its social and environmental context. Individual air quality monitoring demonstrated that particulate levels frequently exceeded upper limits recommended by the WHO. Ethnographic findings revealed the impact of economic scarcity on individual air pollution exposures. It is important to consider sustainable approaches to cleaner air, without re-enacting existing systemic inequities.

III. Top 5 publications since 2020

These are the most important of the 42 papers published in scientific journals by the Gender in Health Group (group member names in bold):

1. Missing men with tuberculosis: the need to address structural influences and implement targeted and multidimensional interventions. Chikovore J, Pai M, Horton KC, Daftary A, **Kumwenda MK**, Hart G, Corbett EL. *BMJ Glob Health*. 2020, 5(5)e002255. doi: 10.1136/bmjgh-2019-002255. PMID:32371568.
2. Partner-delivered HIV self-test kits with and without financial incentives in antenatal care and index patients with HIV in Malawi: a three-arm, cluster-randomised controlled trial. Choko AT, Fielding K, Johnson CC, **Kumwenda MK**, Chilongosi R, Baggaley RC, Nyirenda R, Sande LA, Desmond N, Hatzold K, Neuman M, **Corbett EL**. *Lancet Glob Health*. 2021 Jul;9(7):e977-e988. doi: 10.1016/S2214-109X(21)00175-3. PMID: 34143996.
3. Exploring the evolution of policies for universal antiretroviral therapy and their implementation across three sub-Saharan African countries: Findings from the SHAPE study. **Kumwenda M**, Skovdal M, Wringe A, Kalua T, Kweka H, Songo J, Hassan F, Chimukuche RS, Moshabela M, Seeley J, Renju J. *Glob Public Health*. 2021 Feb;16(2):227-240. doi: 10.1080/17441692.2020.1851386. PMID: 33275872
4. Socio-cultural and economic barriers, and facilitators influencing men's involvement in antenatal care including HIV testing: a qualitative study from urban Blantyre, Malawi. Sakala D, **Kumwenda MK**, Conserve DF, Ebenso B, Choko AT. *BMC Public Health*. 2021 Jan 6;21(1):60. doi: 10.1186/s12889-020-10112-w. PMID: 33407298.
5. Effect of community-led delivery of HIV self-testing on HIV testing and antiretroviral therapy initiation in Malawi: A cluster-randomised trial. Indravudh PP, Fielding K, **Kumwenda MK**, Nzawa R, Chilongosi R, Desmond N, Nyirenda R, Neuman M, Johnson CC, Baggaley R, Hatzold K, Terris-Prestholt F, Corbett EL. *PLoS Med*. 2021 May 11;18(5):e1003608. doi: 10.1371/journal.pmed.1003608. PMID: 33974621.

IV. Translation

The Group's research and close collaborations across MLW, Malawi and Africa resulted in these public health benefit in 2020-2021:

- African Studies Association (ASA) Self-Testing for COVID-19: Are African Communities Prepared to be Key Actors in Case Detection? November 2021;
- PhD Induction Session: Gender Analysis and Intersectionality Framework, LIGHT Consortium, October 2021;
- Adaptation for Scale up Workshop: Adapting an intervention for “maternal depression and partner HIV self-testing “ for potential scale up IN MALAWI - Kings College London, May 2021.

V. Trainees in 2021



Gender in Health Group hosting visitors from the University of Zimbabwe, Kings College London and Kamuzu University of Health Sciences for a workshop. © MLW. Photographer: Pauline Mlogeni.

- **Chikondi Chapuma**, PhD fellow, ‘Understanding maternal infections and their impact on maternal health outcomes in Malawi’, Supervisors: D Lissauer/Kumwenda, Malawian, Active
- **Doreen Sakala**, PhD fellow, ‘Investigating the role of social media as a form of social capital in transitions into and out of sex work in urban settings in Malawi’, Supervisors: Desmond/Kumwenda/Lora, Malawian, Active
- **Carolyn Gondwe**, MSc fellow, ‘Hand hygiene practices among healthcare workers during the Covid-19 era at Livingstone Central Hospital, Zambia’, Supervisor: Kumwenda, Zambian, Active

VI. Future vision

- Develop into an independent multidisciplinary research group within MLW providing theoretical support on gender issues and methodological support in social science;
- Contribute to gender mainstreaming within MLW and incorporation of gender analysis tools in research conduct within the Group and other affiliated groups within MLW and KUHeS;
- Develop an excellent track record of training and hosting researchers at different levels of their careers, securing competitive grants and conducting research that is relevant to local policy needs.



Community Engagement and Bioethics Associate Research Group lead Deborah Nyirenda (2nd row, right) and her multidisciplinary team members strengthen MLW's research by gathering evidence to support the ethical involvement of communities and patients in planned health research. © MLW. Photographer: Hendrina Nkuta.

Community Engagement and Bioethics

I. Overview

The Community Engagement and Bioethics Associate Research Group aim to generate evidence to improve community engagement, public and patient involvement, and ethical conduct of global health research.

Group Head Dr Deborah Nyirenda and a multidisciplinary research team of professionals from the humanities, social science, anthropology, research ethics, public and global health, and nursing apply social science research methodologies on both stand-alone and interdisciplinary research projects. The Group's work strengthens MLW's research by gathering evidence to support ethical involvement of patients and communities in planned health research. Through links with the Global Health Bioethics Network and other partners, the Group is also active in developing young researchers in Social Science research skills to improve community engagement and ethical conduct of global health studies conducted in low- and middle-income countries (LMICs).

Community Engagement and Bioethics current work focuses on activities that seek to:

Enhance ethical, context relevant community engagement approaches in global health research

- Generate evidence on ethical approaches that can improve community engagement in global health research (Mawu Athu study, Deborah Nyirenda, et al).

Improve participant experiences in global health research and service delivery

- Explore research participants' understanding of their roles and responsibilities in clinical research (Gertrude Banda, et al);

- Explore views of research stakeholders about appropriate benefits and compensation for study participation (Wezzie Nyapigoti, et al);
- Develop responsive dialogues to improve public engagement on antimicrobial resistance (AMR) (Eleanor MacPherson, et al);
- Understand caregiver and health provider perceptions of typhoid fever and typhoid vaccine in Urban Blantyre (Sangwani Salim, et al);
- Explore stakeholders views and concerns about COVID-19 vaccine trials in Blantyre (Wakumanya Sibande, et al).

Develop context relevant ethical guidelines for global health research

- Understand ancillary care needs when conducting medical research in two research settings in southern Africa (Blessings Kapumba, et al);
- Investigate research stakeholders' perspectives on sharing research participants' identifiable data between research projects (Mackwellings Phiri, et al);
- Explore ethical challenges faced by field workers (Elvis Moyo, et al);
- Understand the local acceptability of paediatric minimally invasive tissue sampling (MITS) by eliciting the beliefs, ethical and cultural concerns of families, health care workers and other stakeholders (Chris Moxon, et al).

Enhance communication to influence behaviour change

- Understand choice, control and risk in community responses to the Covid-19 epidemic across the health divide to inform public health strategies in Malawi (Doreen Sakala, et al).

II. Scientific achievements 2021

The Community Engagement and Bioethics Associate Group is a new group with 4 papers published in 2021. Key results include:



MLW Community Engagement and Bioethics team members and participants at Mawu Athu study training. © MLW. Photographer: Rachel Mhango.

Enhance provision of ancillary care in East and Southern Africa

- The paper reviewed publications and guidelines on ancillary care practices in Africa. The findings showed that there is lack of consistency in ethical guidelines and approaches for ancillary care. Establishing ethical guidelines on provision of ancillary care as well as systems to ensure accountability is therefore necessary to strengthen ethical research. Kapumba BM, et al, Wellcome Open Res. 2021, 6:164 <https://doi.org/10.12688/wellcomeopenres.16858.1>.

Enhance ethical, context relevant community engagement approaches in global health research

- The study identified ethical issues in community engagement pertaining to structural coercion. Community engagement alone did not address underlying structural inequalities to ensure adequate protection of communities. The results raise questions on how to balance engaging communities to improve recruitment and ensuring ethical conduct of research. (Nyirenda D, et al, BMC Med Ethics. 2020; 21(1):90. <https://doi.org/10.1186/s12910-020-00530-1>).

Improve participant experiences in global health research and service delivery in low literacy settings

- Attention to careful researcher–participant relationships and responsiveness to community perspectives allowed contextualised decision- making around participant compensation. Failure to adequately recognise and compensate participants has its own risks, notably the possibility of ‘ethics dumping’. (Saleh S, et al., *Int. Health*. 2020;12:524– 532. <https://doi.org/10.1093/inthealth/ihaa064>)

Develop context relevant ethical guidelines for global health research

- Human infection studies could be acceptable in Malawi, provided certain conditions are in place. Ongoing assessment of participant experiences and stakeholder perceptions will be required to strengthen human infection research during development and roll-out. (Kapumba BM, et al, *BMC Med Ethics*. 2020;21(1):14. <https://doi.org/10.1186/s12910-020-0454-y>).

Public engagement

- Community meetings: Mawu Athu study briefing and feedback of findings to participating communities;
- Digital storytelling project with community members from urban Blantyre to discuss their health concerns;
- Community meetings, press briefings and animation videos for SARS-CoV Infection Transmission Dynamics and Household impact in Malawi (SCATHIM) (Victor Mwapasa, Linda Mipando, Khuzwayo Jere, Kondwani Jambo, Tonney Nyirenda, Jobiba Chinkhumba, Kamija Phiri, et al);
- Community engagement for an upcoming study-Introduction and evaluation of vaccines for enteric diseases in children in Eastern and Southern Africa (Khuzwayo Jere, Chisomo Nsefula, Nigel Cunliffe, et al);
- Responsive dialogues to improve public engagement on antimicrobial resistance (AMR) (Eleanor MacPherson and Nick Feasey).

III. Top publications in 2021

These are the most important papers published in scientific journals in 2021 by the Community Engagement and Bioethics Associate Group (group member names in **bold**):



Community Engagement is an integral part of ethical and excellent research. © MLW.

1. What do we know about ancillary care practices in East and Southern Africa? A systematic review and meta-synthesis [version 1; peer review: awaiting peer review]. **Kapumba BM**, Desmond N and Seeley J. (2021). *Wellcome Open Res* 2021, 6:164 <https://doi.org/10.12688/wellcomeopenres.16858.1>
2. The Lived Experience Of Participants in an African Randomised trial (LEOPARD): protocol for an in-depth qualitative study within a multisite randomised controlled trial for HIV-associated cryptococcal meningitis. Lawrence DS,

Tsholo K, Ssali A, Mupambireyi Z, Hoddinott G, **Nyirenda D**, Meya DB, Ndhlovu C, Harrison TS, Jarvis JN, Seeley J. *BMJ Open*. 2021 Apr 5;11(4):e039191. <https://doi.org/10.1136/bmjopen-2020-039191>. PMID: 33820784.

3. Engaging communities in non-communicable disease research and interventions in low- and middle-income countries: a realist review protocol. Klingberg S., Adhikari B, Draper CE, Bosire EN, Tiigah P, **Nyirenda D**, Mukumbang FC. *BMJ Open*. 2021 Jul 21;11(7):e050632. <https://doi.org/10.1136/bmjopen-2021-050632>. PMID: 34290072.
4. “At first, I was very afraid”—a qualitative description of participants’ views and experiences in the first Human Infection Study in Malawi [version 1; peer review: 1 approved, 1 approved with reservations]. Mtunthama Toto N, Gooding K, **Kapumba BM**, Jambo K, Rylance J, Burr S, Morton B, Gordon SB, Manda-Taylor L. *Wellcome Open Res*. 2021, 6:89. <https://doi.org/10.12688/wellcomeopenres.16587.1>.
5. Structural coercion in the context of community engagement in global health research conducted in a low resource setting in Africa. **Nyirenda D**, Sariola S, Kingori P, Squire B, Bandawe C, Parker M, Desmond N. *BMC Med Ethics*. 2020 Sept 21;21(1): 90. <https://doi.org/10.1186/s12910-020-00530-1>. PMID: 32957967.

IV. Translation

The Community Engagement and Bioethics Associate Group’s research has contributed to:

- Policy engagement on study findings on how to seek assent on the National Health Sciences Research Committee (NHSRC);
- Policy brief on SARS-CoV-2 infection transmission dynamics and household impact in Malawi (KUHES);et
- Contribution of a case study on ethical dilemmas in a study involving minimally invasive tissue sampling (MITS) in adults who died from COVID-19 at a tertiary hospital in Africa (WHO).



A picture taken by one of Mawu Athu participants, showcasing their priority health concern in relation to access to clean water. © MLW.

V. Trainees

- **Blessings Kapumba**, PhD fellow, ‘The ethics of data prompted ancillary care’, Supervisors: Desmond/Seeley/Nyirenda, Malawian, Active
- **Gertrude Banda**, GHBN fellowship, ‘Are competent adult participants responsible for complying with study requirements and all its obligations once they consent to take part in the study? Expectation vs reality in practice’, Supervisors: Manda-Taylor/Desmond/Nyirenda, Malawian, Active
- **Wakumanya Sibande**, MSc fellow, University of Leeds, Malawian, Active
- **Mackwellings Phiri**, MSc, Liverpool School of Tropical Medicine, UK

VI. Future vision

- Contribute to the strategic development of Social Science theme at MLW.
- Secure independent grants on community engagement and bioethics in emerging global health challenges.
- Contribute to career development of upcoming social scientists at MLW and KUHES.



Shown with other researchers, Dr Marriott Nliwasa is (5th left, front row) and his HIV and TB team use modern surveillance approaches to assess TB risk, disease trends in the population, and the impact of current interventions. © MLW. Photographer: Gift Kayuni.

HIV and Tuberculosis (TB)

I. Overview

There is a global pandemic of tuberculosis (TB) and new tools to control the disease are needed urgently. HIV increases the risk of developing TB. The HIV and TB Associate Research Group aims to:

1. Improve the detection of TB cases and access to highly accurate TB tests in low-income settings;
2. Assess if new drugs can shorten the duration of TB treatment from six to four months. Shorter and more efficacious TB treatment will improve patients outcomes; and
3. Support Malawi's commitment to eliminate TB as a major public health concern by 2035.

Also known as the Helse Nord TB Initiative at the Kamuzu University of Health Sciences (KUHeS), the Group is led by Dr Marriott Nliwasa, supported by Group Administrators Robina Semphere (research and training) and Doris Shani (TB lab). The Group use modern surveillance approaches to assess TB risk, disease trends in the population, and the impact of current interventions. They have strong collaborations with MLW's Population Health Theme, KUHES, national Technical Working Groups (TWGs), and with regional and international policymakers.



The HIV and TB Research Group's current work and activities focus on:

Evaluating and scaling-up new TB diagnostic tests

To determine ways to improve coverage of TB testing for patients and their impact on individual patient outcomes and population-level disease burden, the Group:

Improving diagnosis of infectious diseases: an HIV and TB group laboratory technician at work. © MLW. Photographer: Hussein Twabi.

- Investigate the impact of rolling out digital chest radiography screening and Xpert MTB/RIF testing in health facilities in Blantyre, Malawi on patient outcomes and population-level disease burden;
- Evaluate new approaches of diagnosing TB in children using easily accessible samples such as urine, stool and blood.

Evaluating new TB drug regimens

To assess which patients would benefit from short TB treatment regimens, the Group conduct Phase III trials of novel short-term (4 months) TB treatment regimens, evaluating impact on disease outcomes in specific groups (extra-pulmonary and HIV positive individuals).

Understanding the epidemiology of TB in Blantyre

To understand the determinants of TB incidence in Blantyre, the Group:

- Maintain the geospatial TB surveillance system to observe trends in disease burden, TB case notifications, prevailing TB strains and transmission networks;
- Investigate the impact of TB interventions such as wider coverage of TB testing on overall TB case notifications, prevalence and incidence.

II. Scientific achievements 2021

The HIV and Tuberculosis (TB) research Group continues to be very productive, with 10 papers published in 2021. Key results include:

Evaluating and scaling-up new TB diagnostic tests

- Investigating access to new TB diagnostic tests: The RaPaed study is investigating novel approaches for diagnosing TB in children; and the XACT-TB trial is investigating utility of the Xpert MTB/RIF assay and digital chest radiography for diagnosis of TB in HIV positive individuals.
- Investigating the use of computer-aided digital x-ray TB screening in communities in Blantyre, Malawi (Twabi HH et al. *Trop Med Int Health*. 2021).



Critical to the HIV and TB team's work is conducting research relevant to the communities that they work in. © MLW. Photographer: Mary Chimwaza.

Evaluating new TB drug regimens

- The Group are investigating the determinants of TB treatment outcomes on both the host and pathogen. They have undertaken analyses to understand clinical characteristics of patients with poor outcomes on TB treatment (Manuscripts under review) and completed a study investigating epigenetic mechanisms such as methylation in promoting *Mycobacterium tuberculosis* persistence in the host (Ndhlovu VH et al, *PeerJ*. 2020).

Understanding the epidemiology of TB and identifying community interventions

- We have completed a systematic literature review investigating systematic screening for TB in communities. This was included in the recent WHO guidelines updates 2021 (Burke RM et al, *Lancet Public Health*. 2021).

Public engagement

The Group actively and regularly engage with the public and media in Malawi. This has resulted in the Group:

- Hosting the 2021 Annual TB Research Network conference attended by researchers and media in Malawi and internationally;
- Being featured in four Umoyo Nkukambirana programmes on Times Radio's covering TB prevention, diagnosis and treatment;
- Handing out kits at the launch of a test for TB diagnosis called IRISA-TBTM test that detects a biomarker (gamma interferon);
- Conducting twice per year TB diagnosis workshops for students at the College of Medicine;
- Team members appearing on COVID-19 public awareness radio programmes, an activity covered on national radio and TV.



A 2021 TB and HIV research meeting at the Malawi Sun Hotel Blantyre, a platform for sharing research results with policy makers. © MLW. Photographer: Gift Kayuni.

III. Top 5 publications since 2020

These are the most important of the 40 papers published in scientific journals since 2020, with 10 added in 2021 by the HIV and Tuberculosis (TB) Research Group (group member names in **bold**):

1. Community-based active case-finding interventions for tuberculosis: a systematic review. Burke RM, **Nliwasa M**, Feasey HRA, Chaisson LH, Golub JE, Naufal F, Shapiro AE, Ruperez M, Telisinghe L, Ayles H, **Corbett EL**, MacPherson P. *Lancet Public Health*. 2021 May;6(5):e283-e299. doi: 10.1016/S2468-2667(21)00033-5. PMID: 33765456.
2. Pattern of abnormalities amongst chest X-rays of adults undergoing computer-assisted digital chest X-ray screening for tuberculosis in Peri-Urban Blantyre, Malawi: A cross-sectional study. **Twabi HH**, **Sempere R**, Mukoka M, Chiume L, Nzawa R, Feasey HRA, Lipenga T, MacPherson P, **Corbett EL**, **Nliwasa M**. *Trop Med Int Health*. 2021 Nov;26(11):1427-1437. doi: 10.1111/tmi.13658. PMID: 34297430.
3. Non-Tuberculous Mycobacterial Pulmonary Disease identified during community-based screening for Mycobacterium Tuberculosis: a case report. **Twabi HH**, Mukoka-Thindwa M, **Shani D**, **Nliwasa M**, **Corbett EL**. *Malawi Med J*. 2021 Mar;33(1):65-67. doi: 10.4314/mmj.v33i1.10. PMID: 34422236.
4. Exploring the evolution of policies for universal antiretroviral therapy and their implementation across three sub-Saharan African countries: Findings from the SHAPE study. Kumwenda M, Skovdal M, Wringe A, Kalua T, Kweka H, Songo J, Hassan F, Chimukuche RS, Moshabela M, Seeley J, Renju J. *Glob Public Health*. 2021 Feb;16(2):227-240. doi: 10.1080/17441692.2020.1851386. PMID: 33275872.

5. Characterization of DNA methylation in Malawian *Mycobacterium tuberculosis* clinical isolates. **Ndhlovu V**, Kiran A, Sloan DJ, Mandala W, **Nliwasa M**, Everett DB, Kumwenda B, Mwapasa M, Kontogianni K, Kamdolozi M, Corbett E, Caws M, Davies G. *PeerJ*. 2020 Dec 16;8:e10432. doi: 10.7717/peerj.10432. PMID: 33362962.

IV. Translation

The HIV & TB Research Group has had the following translational impact:

- Membership of the Partnership to enhance technical support for analytical capacity and data use in Eastern and Southern Africa (PERSUADE);
- Contributed to global TB and HIV policy and guidelines;
- Contributed to Malawi National TB treatment guidelines;
- Participated in development of WHO policy guidance on the TB-LAMP assay.

IV. Trainees in 2021

- **Rita Nakiboneka**, PhD fellow, 'Clinical Evaluation of the host gene signature for tuberculosis diagnosis and treatment response monitoring', Supervisor: Sabiti, Ugandan, Active
- **Alice Mnyanga**, MSc Antimicrobial Stewardship, 'Molecular investigation of the aetiology of tuberculosis-like clinical syndromes in adults presenting for primary care in Blantyre, Malawi', Supervisor: Divala, Malawian, Active
- **Tionge Sikwese**, MSc Antimicrobial Stewardship, 'Prevalence of multi-drug resistant tuberculosis disease in clinical isolates in Blantyre and Lilongwe, Malawi', Supervisor: Nliwasa, Malawian, Active
- **Dalitso Kalua**, MSc Tropical Disease Biology, Liverpool School of Tropical Medicine, Malawian, Active
- **Madalo Mukoka**, Pre-PhD Intern, 'Investigating the impact of self-care interventions in low- and middle-income countries: a case study of Malawi', Supervisors: Choko/Nliwasa, Malawian, Active
- **Takondwa Msosa**, Pre-PhD Intern, 'Investigating facility-based interventions to improve tuberculosis screening and case detection rates', Supervisors: Nliwasa/Choko/P MacPherson, Malawian, Active
- **Hussein Twabi**, Pre-PhD Intern, Supervisor: Nliwasa/P MacPherson, Malawian, Active

VI. Future vision

In the next 2 to 5 years, the Group will focus on:

- Expanding the PhD and postdoctoral training programme;
- Implementing TB treatment shortening trials (Phase III and late Phase II);
- Conducting cluster-randomised trials to improve access to TB diagnostics;
- Closer engagement with the Malawi National TB Control programme and significant contribution to national research agenda; and
- Establishing meaningful international collaborations with researchers in Africa and overseas.



Implementation Research in Health Associate Group Head Augustine Choko (3rd left) with site members team of the FISH Study. © MLW. Photographer: Zuze Matoliro.

Implementation Research in Health (IRH)

I. Overview

Finding solutions to pressing public health problems such as HIV, tuberculosis (TB) and neglected tropical diseases such as schistosomiasis is a priority for policymakers in Malawi, the region and around the globe. Reducing the time, cost and the size of trials is an important aspect of study design that requires attention and expertise.

The Implementation Research in Health (IRH) Associate Group has interests and experience in designing, conducting and reporting innovative trial designs such as adaptive multi-arm multi-stage cluster randomized trials in HIV and TB. Led by Dr Augustine Choko, and linked to the Public Health Group led by Dr Peter MacPherson, the Group design innovative tools and studies with strong input and engagement from policymakers to generate results that have led to policy changes at the local level and direct impact internationally, at the WHO. Group members have expertise in epidemiology, randomised trials, qualitative research, and health economics.

The Group has strong links with the Helse Nord TB Initiative at Kamuzu University of Health Sciences (KUHeS) headed by Dr Marriott Nliwasa through the TB lab and joint grants and trainees, and mutual attendance at scientific meetings and strategic workshops.

Engaging with key stakeholders and policymakers, the Group's focus is trial designs and study pathways, particularly in identifying efficient study designs that address pressing public health questions and lead to timely public health findings. Current Implementation Research in Health Group work and activities engage in:

Identifying optimal study (trial) designs to address public health questions

- Use innovative trial methodology such as adaptive, multi-arm multi-stage, and stepped wedge cluster randomized trial designs to investigate urgent public health questions;
- Using complex understanding of local context, to design novel interventions that address public health problems.

Identifying optimal study pathways to increase policy uptake

- To evaluate key components or studies that may need to be developed before the final trial is conducted to build a coherent investigation that addresses community needs;
- To identify and engage key stakeholders and policymakers to ensure that results from studies inform policy changes or policy implementation modifications.

The **FISH Project** [Creating demand for Fishermen's schistosomiasis and HIV services (FISH): piloting and delivery of a 3-arm cluster randomized control trial (cRCT) in Malawi] began implementation in June 2021 and is set to address both schistosomiasis and HIV in an integrated way for fishermen. Both HIV and schistosomiasis are serious public health problems for both fishermen and fishing communities in general. FISH is co-funded by the Wellcome Trust & the National Institute for Health Research in UK under an Intermediate International Fellowship to Dr Augustine Choko.



The Implementing Research Health Associate Group is conducting the FISH study, a cluster randomised control trial of treatment for schistosomiasis. © MLW. Photographer: Zuze Matoliro.

II. Scientific achievements 2021

The Implementation Research in Health team continue to be very productive, with 10 papers published in 2021. Key results include:



Augustine Choko (right) discussing microscopy for detecting eggs of *schistosoma hematobium* in Mangochi. © MLW. Photographer: Zuze Matoliro.

Identifying optimal study (trial) designs to address public health questions

- The IRH team conducted a pre-national scale up cluster randomized trial to investigate programmatic impact on HIV testing among male partners and sexual contacts of people testing HIV positive in health facilities following receipt of HIV self-test kits from pregnant women and index clients. (*Lancet Global Health*. 2021; Jul;9(7):e977-e988].
- IRH replicated key results shown in our previous trial demonstrating that the offer of an HIV self-test kit was acceptable, safe and led to significant increase in the percentage of men and sexual contacts who tested for HIV. This work has been pivotal in informing national scale up of HIV self-testing in clinics in Malawi.
- The IRH team continue to engage with policymakers as co-chairs, WHO Technical Working Group on HIV Self-Testing (P Macpherson, AT Choko), and as members of the Malawi HIV self-testing task force.
- Contributed to WHO HIV testing Services Guidelines (AT Choko).

Public engagement

- Guest speaker at the Wellcome meeting for Fellows 2021 (AT Choko).

III. Top 5 publications since 2020

These are the most important of the 10 papers published in scientific journals in 2021 by the Implementation Research in Health (IRH) Associate Group (member names in **bold**):

1. Partner-delivered HIV self-test kits with and without financial incentives in antenatal care and index patients with HIV in Malawi: a three-arm, cluster-randomised controlled trial. **Choko AT**, Fielding K, Johnson CC, **Kumwenda MK**, Chilongosi R, Baggaley RC, Nyirenda R, **Sande LA**, **Desmond N**, Hatzold K, Neuman M, **Corbett EL**. *Lancet Glob Health*. 2021 Jul;9(7):e977-e988. doi: 10.1016/S2214-109X(21)00175-3. PMID: 34143996.
2. Computer-aided X-ray screening for tuberculosis and HIV testing among adults with cough in Malawi (the PROSPECT study): A randomised trial and cost-effectiveness analysis. **MacPherson P**, Webb EL, **Kamchedzera W**, Joeke E, Mjoli G, Lalloo DG, **Divala TH**, **Choko AT**, **Burke RM**, Maheswaran H, Pai M, Squire SB, **Nliwasa M**, **Corbett EL**. *PLoS Med*. 2021 Sep 9;18(9):e1003752. doi: 10.1371/journal.pmed.1003752. *eCollection* 2021 Sep. PMID: 34499665.
3. Men's comfort in distributing or receiving HIV self-test kits from close male social network members in Dar Es Salaam, Tanzania: baseline results from the STEP project. Matovu JKB, Mbita G, Hamilton A, Mhando F, Sims WM, Thompson N, Komba AN, Lija J, Zhang J, van den Akker T, Duncan DT, **Choko AT**, Conserve DF. *BMC Public Health*. 2021 Sep 24;21(1):1739. doi: 10.1186/s12889-021-11806-5. PMID: 34560878.
4. Costs of integrating HIV self-testing in public health facilities in Malawi, South Africa, Zambia and Zimbabwe. **Sande LA**, Matsimela K, Mwenge L, Mangenah C, **Choko AT**, d'Elbée M, Majam M, Mostert C, Matamwandi I, Sibanda EL, Johnson C, Hatzold K, Ayles H, Cowan FM, Corbett EL, Neuman M, Maheswaran H, Meyer-Rath G, Terris-Prestholt F. *BMJ Glob Health*. 2021 Jul;6 (Suppl 4):e005191. doi: 10.1136/bmjgh-2021-005191. PMID: 34275874.

5. Socio-cultural and economic barriers, and facilitators influencing men's involvement in antenatal care including HIV testing: a qualitative study from urban Blantyre, Malawi. **Sakala D**, **Kumwenda MK**, Conserve DF, Ebenso B, **Choko AT**. *BMC Public Health*. 2021 Jan 6;21(1):60. doi: 10.1186/s12889-020-10112-w. PMID: 33407298.



Implementation team for the HIV self-testing study in urban Blantyre. © MLW. Photographer: Wisdom Shonga.

IV. Translation

Implementation Research in Health's active engagement with key stakeholders and policymakers has resulted in innovative tools and carefully designed research studies that deliver results in a timely manner and have an important public health impact. These include:

- Together with the Public Health Group, Implementation Research in Health developed the eElectronic Participant Locator (ePAL) app, a GPS-based system that allows precise, remote geolocation of peoples' households from, for example, study clinics. Widely adopted by MLW research groups, ePAL has been used in other international research settings, including in Indonesia. The Malawi National TB Programme plans to integrate ePAL into its TB monitoring and surveillance systems.

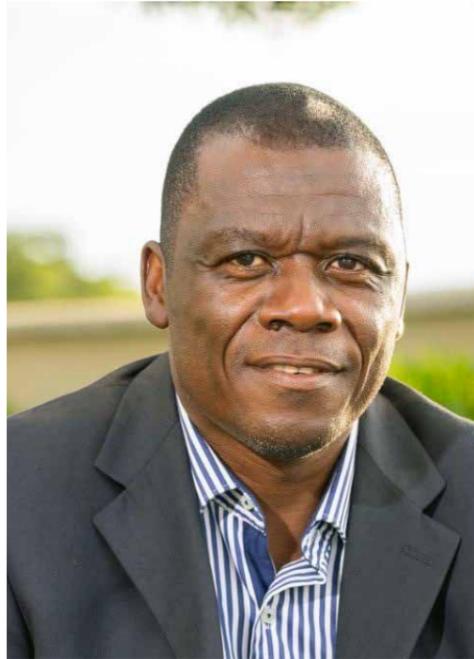
V. Trainees in 2021

- **Madalo Mukoka**, Pre-PhD Intern, 'Investigating the impact of self-care interventions in low- and middle-income countries: a case study of Malawi', Supervisors: Choko/Nliwasa, Malawian, Active
- **Takondwa Msosa**, Pre-PhD Intern, 'Investigating facility-based interventions to improve tuberculosis screening and case detection rates', Supervisors: Choko/Nliwasa/MacPherson, Malawian, Active
- **Hope Kajawa**, Pre-MSc Intern, FISH project, Supervisor: Choko, Malawian, Active

VI. Future vision

- Lead intervention design & evaluation aiming to inform national and international policy;
- Rapid integration & scale-up of tested decentralized models of service delivery for the Malawi Ministry of Health (MoH);
- Support regional adoption of Malawi models;
- Continue to support training in epidemiology and statistics.

The Operations Departments



We describe our organisation as a tree rooted in Malawi. The tree has branches which bear fruits which are products such as vaccines, drugs, diagnostics and policy — those are fruits — and the research groups bring those fruits out. But there is no plant that does not have roots. The roots are the Operations Departments: infrastructure, vehicles, Health & safety, field workers, nurses, clinicians, statistics — all these departments — and the thing has to work together as a whole.

Led by Aubrey Chalira Phiri, Chief Operating Officer, the Operations Departments are the roots of MLW, ensuring operational excellence across the organization to meet MLW’s strategic goals. The Operations Departments work in partnership with the research teams across MLW to drive excellence, transformation, and improved performance within and across functions. The Operations Departments are responsible for MLW’s budget and financial performance, human resource management, the management of its facilities, information technology and communications.

Chief Operating Officer Aubrey Chalira Phiri. © MLW.

The MLW Operations Departments include:



Finance and Grants maintains a robust financial system to maximise financial resources. © MLW.

Finance and Grants is led by Edward Namalima. It aims to provide excellent financial and grants support to all MLW stakeholders while maintaining a robust financial system that maximizes financial resources, maintains probity and integrity in all financial matters, and ensures conformity with international and domestic laws.

Led by Limbani Medi, **Human Resources** assists MLW to recruit talent to better meet our employees’ needs while promoting MLW goals to ensure that MLW develop and maintain an efficient, effective, loyal and flexible workforce that is adaptive to change.



The Human Resources Department ensures that the workforce is flexible. Mother’s Day Celebration 2021. © MLW. Photographer: Zuze Matoliro.



The Human Resources Department ensures that the workforce is well engaged. Staff Forum, August 2021. © MLW. Photographer: Pauline Mlogeni.



Facilities & Fleet, led by Elia Ng’ambi, **Field Sites Management**, led by Chimwemwe Theu, and **Health and Safety**, led by Wezzie Gondwe with oversight by **Head of Operations Tamara Chipasula**, provide comprehensive services including planning and management support, to ensure that MLW infrastructure and related physical resources can support research work and all other institution work, in a safe, effective and efficient manner across sites. At the same time ensuring a safe working environment in all MLW spaces.



The Facilities & Fleet, Field Sites, and Health and Safety teams ensure that infrastructure and other physical resources are available to support research. © MLW. Photographer (both photos): Hendrina Nkuta.

Headed by Owen Mwenefumbo, **Information Technology** provides access, development and support services to operations and research staff so that they can conduct their work in a reliable, effective, and efficient information technology environment in pursuit of MLW objectives and priorities.

The Information Technology team (in caps) assisting members of staff during one of its IT Clinics. December 2021. © MLW. Photographer: Hendrina Nkuta.





The Communications and Public Engagement component ensures that there is ethical research practice. © MLW. Photographer: Alick Chimzere.



Headed by Lindiwe Mafuleka, **Communications and Public Engagement** ensures effective internal and external communications, and promotes ethical research practice by facilitating two-way engagement between researchers and research participants and empowering communities to make informed contributions in research.

The Communications and Public Engagement component ensures that there is ethical research practice. © MLW. Photographer: Zuze Matoliro.

Enhancing organizational efficiency and effectiveness in 2021

- During the year, MLW enhanced its Information Technology platform and fiber connectivity to support remote working by ensuring that the infrastructure was not only robust and stable, but also secure, given the heightened reliance on the IT platform for communication, collaboration, and operations.
- As remote working became a reality, MLW adapted by strengthening its financial management systems, internal controls and monitoring of financial risks. The production of financial reports and research grants management was enhanced. The annual external audit for 2021 was successfully completed and received an unqualified opinion.
- The Risk Management function, under the Head of Operations, developed the MLW Risk Appetite Statement. We recognise as an organisation that we must take risks to achieve our objectives, and to manage this we introduced a risk appetite statement during the year. We must take risks in a controlled manner, reducing exposure to a level deemed acceptable by MLW Senior Management. By defining our risk appetite, we can set boundaries for risk-taking.



The Kafukufuku Building is one of the new buildings within the MLW premises. © MLW. Photographer: Hendrina Nkuta.

Regular risk reports were prepared and shared with Senior Management strategic decision making. Risk management measures were put in place to address the risks facing MLW. MLW continued to undertake assurance activities to improve the control environment at both operational and research levels.

- Over the year, we have made significant progress to enhance, improve and build on our Human Resources function across the organisation. Our aim is to enable our people to fulfil their full potential, and as a result, support

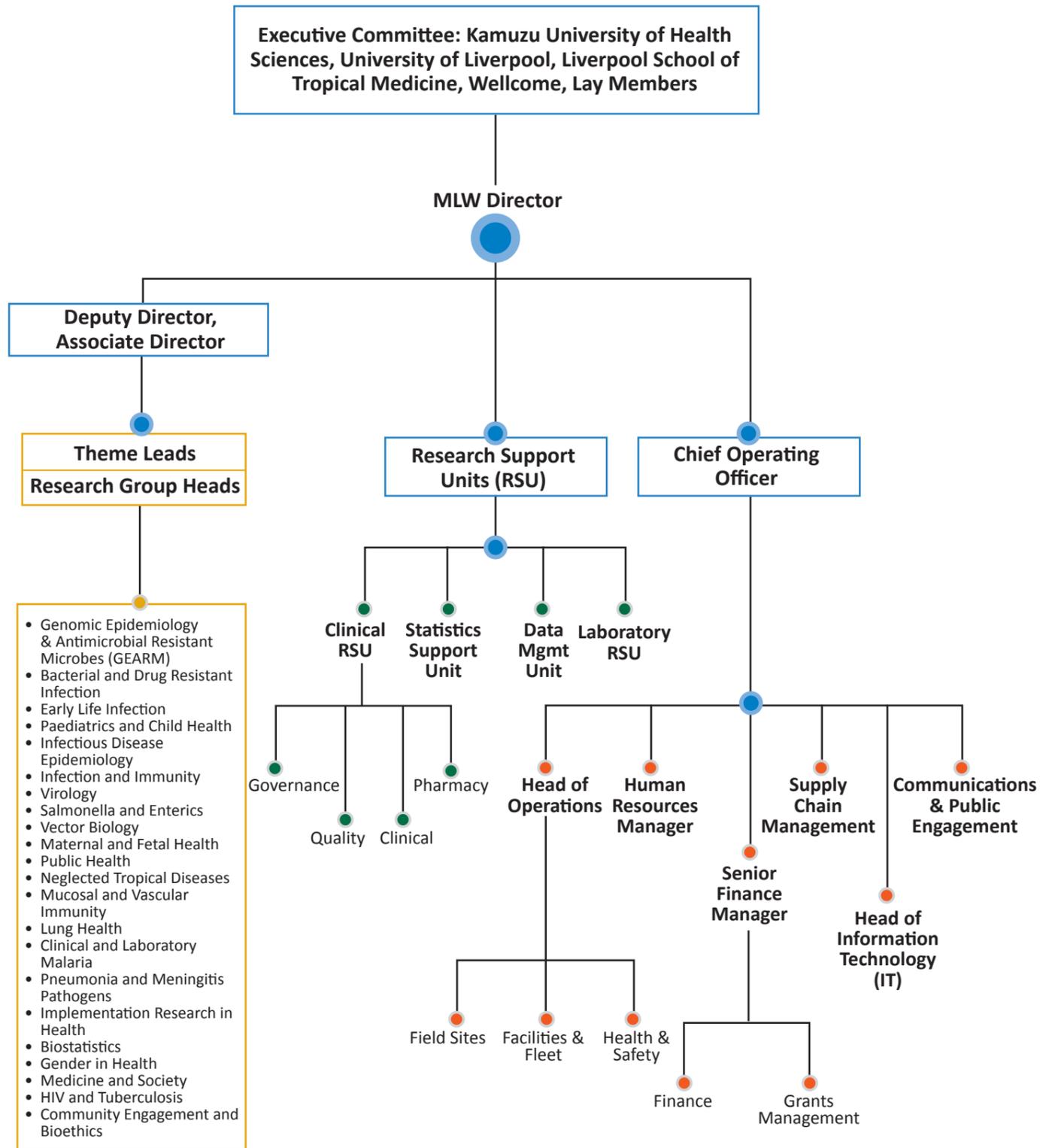
the organisation in achieving our goals. In addition to delivering COVID-19 activities, this has involved: improved our guidance and support for appraising performance, including specific training/coaching sessions. Human Resource undertook programs to build mid-level staff leadership skills and capacities.

- In October 2020 MLW implemented a new safeguarding policy for protecting vulnerable study participants. In addition, HR updated the Staff Handbook to implement further safeguarding measures. Focused training in safeguarding was identified as a strong mitigation measure, and in this regard, MLW arranged training of all MLW staff on Safeguarding with particular focus on Safeguarding Champions, MLW leadership and women at MLW – the training aimed to ensure that all MLW staff understand safeguarding and understand the reporting mechanisms.
- Our application to the Malawi Government for tax exemption on stipends paid to our students was approved. This approval is significant as it confirms that Our research training programme is recognized and appreciated by the Malawi Government
- **Space and Construction:** We are excited that the construction of the long-awaited Clinical Research Excellence and Training Open Resource (CREATOR) has started. The CREATOR is a five Storey and 3,350 square meters research and training facility. The value of CREATOR for Malawi and the region will be a step-change in the scale of clinical research. In addition, the Kafukufuku building was completed during the year. This facility houses our freezer archive with capacity for up to 50 freezers, space for our field workers and the pharmacy unit. Finally, construction of the Chikwawa building has started and we believe that Chikwawa offers a strategically important base for research in a high disease burden rural setting close to Blantyre.



Enabling works of the CREATOR Building at MLW premises. © MLW. Photographer: Aubrey Chalira Phiri.

Functional map of MLW

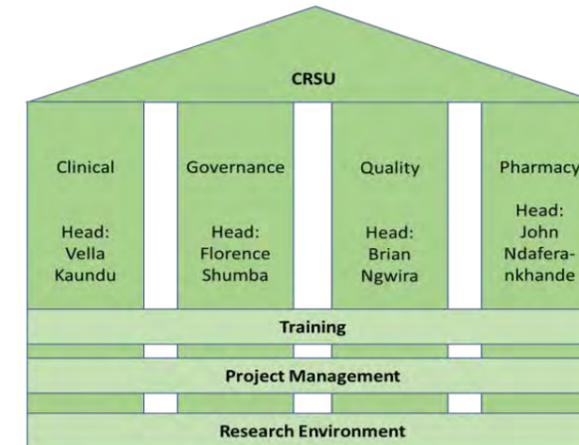


Research Support Units

Research Support Units (RSU) underpin quality in all aspects of MLW Research. The RSU leads are Malawi resident scientists and part of the Core team. All new projects consult with the RSU teams during planning, running and closing out of students to ensure excellence in clinical, laboratory and data aspects of the work.

Clinical Research Support Unit (CRSU)

The Clinical Research Support Unit (CRSU) provides support to researchers to enable them to have the resources and confidence for the life span of research. From the conceptual idea, approval process, implementation and reporting to publication and close out. As shown in the figure, CRSU has four sections: Clinical, Governance, Quality, and Pharmacy. There are three cross-cutting activities: Training, Project Support and Research Environment.



The clinical (left) and pharmacy (right) components are part of the Clinical Research Support Unit. © MLW. Photographers: Lindiwe Bandazi Mafuleka (left); MLW (right).



Laboratory Research Support Unit (LRSU)

Headed by Brigitte Denis, the Laboratory Research Support Unit (LRSU) provides high quality, Good Clinical Laboratory Practice (GCLP) and ISO 15189 compliant, clinically relevant, and timely laboratory support to all MLW programme research activities and clinical services, as required.

There are five diagnostic sections: Microbiology, Blood Science, Parasitology, TB, and Molecular Diagnostics. Each diagnostic section has led and core team and Molecular Microbiology, Immunology, and Environmental Microbiology research laboratories. The Lab Steering Committee (LSC) provides the necessary oversight, financial decision making and linkage between core lab functions and laboratory-based research projects.

The MLW lab has 5 diagnostic sections - Microbiology, Blood Science, Parasitology, TB and Molecular Diagnostics. © MLW.

Data Management Unit (DMU)

The Data Management Unit (DMU) is led by Clemens Masesa with the primary objective of providing first-class data management support throughout the research life cycle to research projects at MLW. They achieve this by:

- Providing end-to-end data management to MLW-based research projects;
- Conforming to National, Regional and Internationally accepted data management standards and best practice.
- Leveraging information and communication technology (ICT) to make our processes as efficient as possible.
- Providing world class, contemporary and engaging training opportunities in the data management domain.

The DMU is divided into five major sections: Data Quality Management, Data Platforms, Quantitative Data, Qualitative Data, and Application Development.



The Data Management Unit leverages ICT to make data collection and management efficient. © MLW.



The Statistics Support Unit team facilitated a Cooper-Smith meeting as part of supporting statistical studies at MLW. © MLW. Photographer: Pauline Mlogeni.

Statistics Support Unit (SSU)

Run as a part of the Biostatistics Associate Research Group (see Groups) and led by Marc Henrion, the primary role of the SSU is to provide statistical support when required by any MLW study. The statisticians provide advice regarding study design, statistical analysis, and interpretation of the results.

SSU also provides support and training to individual researchers, supporting the operational departments and being a good neighbour to other in-country institutions. Finally, the SSU helps foster the careers of biostatistical researchers at MLW and as such to develop a methodical research agenda and establish and maintain a vibrant network with biostatistical researchers across the globe. Figure 1 summarises the roles of the SSU.



Operations Strategic Plan

During the year, we finalized our MLW's Operations Strategic Plan for 2021–2023. The development of the plan was a true collaboration by the entire operations team and is full of the exciting work we will be doing to support science and research.

The strategic plan builds on our past and serves as a roadmap for the next two years. We've always had a clear and bold operations vision of leading in providing efficient and quality operations services to support MLW's mission of *conducting excellent and cutting-edge research and training*, and now, thanks to the progress we have been making, that vision is increasingly in sight. The ambitious, detailed plan lays out what we'll be doing next two years to accelerate achieving this long-term goal.

Our 2021-2023 departmental strategies, work plans, and personal performance goals are all linked into this two-year strategy. Everything we do is aimed at maximizing the impact of MLW vision of *science driving health and wellbeing in Malawi*.

The operations strategic plan focuses on how operations, in collaboration with its stakeholders will broaden and deepen impact and multiply this impact through partnerships approach. Here are some of the highlights of this operations strategic plan:

- Attract and retain high performing and committed staff.
- Expand MLW's visibility by highlighting research and training excellence.
- Maintain long-term financial sustainability and grow income streams.
- Deliver fit-for-purpose information reporting systems and data management.
- Ensure risk mitigation, compliance and accountability.
- Facilitate growth through fit-for-purpose research and academic labs and facilities.
- Provide an effective and consistent approach to research governance, ethics and sponsorship.

Our goals are ambitious, and the need is vast and urgent. Let's think big, move fast and *support the flexibility of science!*

MLW Finance Strategy

The Finance Strategy for MLW aims to build from our current sound financial position and set a strategy which will ensure our long-term financial sustainability while being mindful of the need to be more agile and responsive than ever before as we plan a step-change in our operations with the coming of the CREATOR in the next 24 months. The strategy will be implemented within a framework of risk mitigation and accountability that does not stifle innovation. Within our Operations Strategic Plan, the following four objectives are of particular relevance to the Finance Strategy.

1. Secure a long-term financial sustainability;

MLW must be financially sustainable in order to achieve our strategic aims. Expanding MLW's research and training through competing effectively for appropriate capacity development, student training and research funding from major global donors is an essential part of this. We aim to continue to grow in a controlled and predictable fashion and develop our activities and ensuring that we have the financial capacity to meet challenges and opportunities as they arise.

We have seen our annual income grow from £7.5m in 2018 to £12.0m in 2021 with research/training income having grown from £5.0m to £8.2m in the same period. It is therefore vital that we build upon this performance in recent years and continue to be financially sustainable in future. Financial sustainability will be much more than ensuring that MLW covers its core costs each year. We would consider MLW financially sustainable if, we are recovering full direct costs for our research and training activities and recharging to research studies a significant part of our overheads.

Good financial planning will be at the heart of our operations. We continue building a coherent approach to budgeting, proposal development and monitoring across all research groups and departments. At the centre of it all is ensuring that our operations support cost base remains appropriate and proportionate to our research and training activities.

2. Maintaining effective and appropriate governance and internal controls;

We need ensure that we discharge our duties properly with regard to how we spend the funds provided to us by our partners and funders. It is vital that we maintain effective and appropriate governance and internal controls through the following initiatives:

- Satisfy the requirements of other external bodies such as funders, regulators, auditors and banks, which is necessary to maintain our financial standing and our ability to raise financing in future;
- Minimise the risk of fraud, bribery and other financial irregularities, which, if allowed to occur, might lead to financial loss or a damage to our reputation;
- Senior management and Executive Committee able to make informed strategic decisions with confidence in the underlying financial and operational information provided to them.
- We aim to focus on risk mitigation measures to limit the number of non-compliant events and potential damage to our reputation in research excellence.

We shall maintain effective governance by ensuring that we have clear, appropriate and timely procedures, policies and guidelines which are reviewed regularly, updated when necessary and complied by all relevant staff. We will work towards embedding a compliance culture within MLW and providing adequate resources to ensure that our policies, procedures and regulations are followed.

3. Ensure a Robust IT platform, fit-for-purpose Enterprise Resource Planning and information reporting systems.

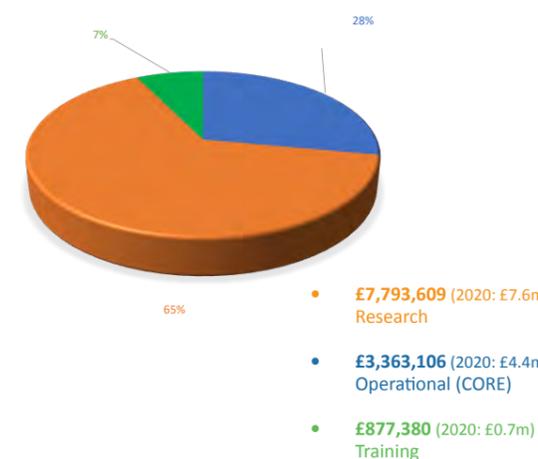
MLW is a growing organisation with an evolving strategy which rely heavily on a robust and flexible information systems. This is driven by the increasing demand for real-time accurate financial information that is flexible to organisational needs. Working in such a complex environment means our systems and processes need to match 21st-century expectations and deliver the right information to the right person at the right time. An upgraded finance system, integrated with project/grant management processes and linked to other business-critical operations, will increase transparency, improve decision-making, and deliver efficiency savings across MLW.

4. Striving for efficiency and value-for-money (VFM) in all activities.

It is vital that there is continual review and re-assessment of our cost base to ensure that only necessary and strategically-driven expenditure is maintained and that costs are not allowed to continue simply because they have been incurred historically. VFM for procurement will be achieved through robust sourcing processes, through enhanced collaboration with user departments, good contract management and a high level of supplier engagement.

As core to the finance strategy, IT is vital that the importance of efficiency and VFM is understood and followed by all staff and not just those within the Finance department. All staff will be provided with the tools/guidelines to make informed decisions when purchasing goods or services for MLW. This will include timely and comprehensive budget information and assistance in securing the best prices for goods required.

2021 Financial Summary

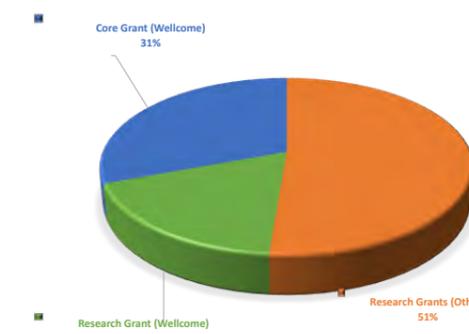


Total Institute Expenditure £12,034,095 (2020: £12.75m)

2021 is the third year into the current quinquennial funding cycle (Mar 2018–Feb 2023). Annual expenditure has grown from £7.5m in 2018 to £12.0m in 2021. Total staff costs are £7.1m (58.9% of total expenditure). The Operational (CORE) expenditure of £3.3m is net of recharges of £0.96m which have been included the expenditure for Research. The Research costs include £0.72m indirect costs recovery as provided in respective grant agreements.

Total Operating Revenue £12,045,558 (2020: £12.03m)

The operating revenue is based on actual income received during the year. Funding for MLW is split into two main categories; CORE funding towards operational expenses and research/training funding. MLW has a £25.08m five (5) -year Core grant from Wellcome. Like any other public clinical research centre, our research is funded through competitive research grants from a mix of funders including Wellcome (26% of research grants). During the year we had 110 active research grants (projects) with an average funding of £72k.



Going Concern

The organisation's Senior Management have reviewed whether it is appropriate for the financial statements to be prepared on a going concern basis. MLW has in principle received its five-year (Mar. 2018 to Feb. 2023) Core grant funding from Wellcome as the grant is unconditional. Wellcome has further confirmed the intention for a two-year costed extension of this current Core grant. Taking into account this confirmed funding coupled with the consistent performance of attracting research income through competitive bids, Senior Management believes that MLW has sufficient capital on hand to satisfy working capital requirements for the foreseeable future.

Appendix A - Collaborators

Mucosal and Vascular Immunology

1. Prof. David Russell, Macrophage biology, Mycobacterium tuberculosis challenge models, Cornell University, USA
2. Prof. Steffen Stenger, CD8 T cell biology during Mycobacterium tuberculosis infection, University of Ulm, Germany
3. Prof. Saye Khoo and Prof. Gerry Davies, Pharmacology of anti-TB drugs, University of Liverpool, UK
4. Prof. Ntobeko Ntusi, HIV vasculopathy, University of Cape Town, South Africa
5. Prof. Paul Garside and Prof. James Brewer, TCR biology and supervision of PhD fellow, University of Glasgow, UK
6. Prof. David Dockrell, HIV infection of macrophages and supervision of PhD fellow, University of Edinburgh, UK
7. Prof. Alex Sigal and Prof. Thumbi Ndung'u, Immunopathogenesis of HIV/TB co-infection, African Health Research Institute, South Africa
8. Prof. David Laloo, Clinical Trials of HIV associated cryptococcal meningitis treatment, Liverpool School of Tropical Medicine, Liverpool, UK
9. Prof. Giancarlo Biagini, Cell Biology and TB Drug Discovery, Liverpool School of Tropical Medicine, Liverpool, UK
10. Prof. Alex Shalek, Computational and Systems Biology, Massachusetts Institute of Technology, Boston, USA
11. Prof. Bertie Squire, Tuberculosis pathogenesis, Liverpool School of Tropical Medicine, Liverpool, UK

Bacteria and Drug Resistant Infections

1. Nick Thomson, Genomic analysis, Wellcome Sanger Institute, UK
2. Clare Chandler, Antimicrobial usage and social science, London School of Hygiene & Tropical Medicine, UK
3. Nicola Elviss, Environmental microbiology, Public Health England, UK

4. Chris Jewell, Statistical modelling, Centre of Health Informatics Computing and Statistics (CHICAS), University of Lancaster, UK
5. Nick Grassly, Spatial statistics, Imperial College London, UK
6. Peter Diggle, Spatial Statistics, Centre of Health Informatics Computing and Statistics (CHICAS), University of Lancaster, UK
7. Henry Kajumbula, Anne Katahoire, DRUM, Makerere University, Uganda
8. Andrew Singer, DRUM, Centre for Ecology and Hydrology, Wallingford, UK
9. Paul Turner, COMRU, Cambodia
10. Richard Quilliam, Biological and Environmental Sciences, University of Stirling, Stirling, UK
11. Tracy Morse, Civil and Environmental Engineering, University of Strathclyde, Glasgow, UK

Salmonella and Enterics

1. Audino Poddo, VAcciNTS GMMA vaccine, Novartis Vaccines Institute for Global Health (NVGH), Italy
2. Andy Pollard, STRATAA, University of Oxford, UK
3. Alison Simmons, Mucosal immunity, University of Oxford, UK
4. Kathy Neuzil, TyVAC, University of Maryland, Baltimore, USA
5. Gordon Dougan, STRATAA, University of Cambridge, UK
6. Steve Baker, Serology, University of Cambridge, UK
7. Florian Marks, Cost of illness, University of Cambridge, UK
8. Jay Hinton, Strain evolution, University of Liverpool, UK
9. John Clemens and Firdausi Qadri, STRATAA, International Centre for Diarrhoeal Disease Research, Bangladesh
10. Jan Jacobs, VAcciNTS, Institute of Tropical Medicine Antwerp, Belgium

11. John Crump, VAcciNTS, University of Otago, New Zealand
12. Daniela Ferreira, Immunology, Liverpool School of Tropical Medicine, Liverpool, UK
13. Galit Alter, Systems serology, Harvard University, USA
14. Adam Cunningham, Systems serology and proteomics, University of Birmingham, UK
15. Sam Kariuki, Kenya Medical Research Institute (KEMRI), Kenya
16. Ellis Owusu-Dabo, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
17. Abdramane Soura, University of Ouagadougou, Burkina Faso

Virology

1. Prof. Nigel Cunliffe, On various rotavirus studies in Malawi, University of Liverpool, UK
2. Prof. Miren Iturriza-Gomara, On various rotavirus studies in Malawi, PATH, Geneva, Switzerland
3. Prof. Carl Goodyear, On Rotavirus B cell repertoire sequencing, University of Glasgow, UK
4. Dr Al Leslie, On rotavirus B cell work, African Health Research Institute (AHRI), South Africa
5. Dr Martin Nyaga, On whole genome sequencing of rotavirus strains collected from Malawi, Ghana, and South Africa, University of Free State, South Africa
6. Dr Francis Denis, On whole genome sequencing of rotavirus strains collected from Malawi, Ghana, and South Africa, University of Ghana, Ghana
7. Dr Carl Anderson, On Rotavirus B cell repertoire sequencing, Wellcome Sanger Institute, UK
8. Prof. Julie Bines, On RV3-BB clinical trial conducted in Malawi, Murdoch Children's Research Institute (MCRI), University of Melbourne, Australia
9. Dr Virginia Pitzer, Modeling the impact and cost-effectiveness of next-generation rotavirus vaccine strategies in low- and middle-income countries, Yale School of Public Health, New Haven, USA
10. Dr Chrispin Chaguz, Whole genome sequencing of rotavirus strains, Yale University, USA

11. Dr Celeste Donato, on sequencing of enteric pathogens, Murdoch Children's Research Institute (MCRI), University of Melbourne, Australia

Maternal and Fetal Health

1. Dr Luis Gadama, Dr Gladys Gadama, Dr Sam Meja, Department of Obstetrics and Gynaecology, Kamuzu University of Health Sciences
2. Dr Fannie Kachale, Dr Malangizo Mbewe, Mrs Rose Bilesi, Dr Owen Musopole, Ministry of Health, Malawi
3. Dr Oludapo, Dr Bonnet and Dr Althabe, Maternal and Reproductive Health Team, World Health Organisation, Geneva, Switzerland
4. Prof. Andrew Weeks, Collaborator on Uganda based work, University of Liverpool, UK
5. Prof. Lumaan Sheik, Collaborator for Pakistan based work, Aga Khan University, Pakistan
6. Prof. Arri Coomarasamy, Collaborator on PPH related work and global health trials, University of Birmingham, UK
7. Prof. Karla Hemmings and Prof. Jon Deeks, Statistical collaborators (on cluster trial methodology and test accuracy statistics respectively), University of Birmingham, UK
8. Prof. Address Malata, collaboration on maternal sepsis trials, Malawi University of Science and Technology, Malawi
9. Dr Nicola Desmond, Maternal sepsis collaborator, Liverpool School of Tropical Medicine, UK
10. Prof. Tracy Roberts, Economics collaborator for maternal sepsis work, University of Birmingham, UK
11. Dr Fabiana Lorencatto, Maternal sepsis collaborator, University College London Centre for Behavioural Change, UK
12. Dr Lou Atkins, Behaviour change collaborator for Diplomatic refunding application, University College London Centre for Behavioural Change, UK
13. Dr Kenneth Mugabe, Maternal sepsis collaborator, Makerere University Hospital, Mbale, Uganda
14. Prof. Musa Mhlanga, Prof. Mihai Netea, Ass. Prof. Simon Van Heering, Trained immunity in BCG vaccinated African infants, Radboud Institute, Netherlands

15. Dr Mohammed Lamorde, Dr Judith Nanyondo, Dr Catriona Waitt, Infectious Diseases Institute, Infectious Diseases Institute, Uganda
16. Prof. Catrin Tudur Smith, Statistical collaborator on study methodology for Diplomatic refunding, University of Liverpool, UK
17. Dr Elizabeth Chodzaza, Dr Effie Chipeta and Dr Kondwane Kwaza, Kamuzu University of Health Sciences, Malawi
18. Dr Peter Mwabe, Dr Catherine Mkandawire, Dr Muriel Syacumpi, Diplomatic collaborator, Lusaka Apex Medical University, Zambia
19. Prof. Sarah Stock, Prof. Rebecca Reynolds, Dr Chelsea Morroni, Dr Robert Stewart, University of Edinburgh, UK
20. Prof. Amelia Crampin, Diplomatic collaborator, Malawi Epidemiology and Intervention Research Unit, University of Glasgow, UK

Public Health

1. Prof. Madhukar Pai, McGill University, Canada
2. Prof. Jeramiah Chakaya, Respiratory Society of Kenya
3. Dr Bruce Kirenga, Makerere Lung Institute, Uganda
4. Dr John Bimba, Zankli Research Centre, Nigeria
5. Prof. Liz Corbett, London School of Hygiene & Tropical Medicine, UK
6. Prof. James Carpenter, London School of Hygiene & Tropical Medicine, UK
7. Prof. Neil Martinson, Perinatal HIV Research Unit, Soweto, South Africa
8. Prof. Ted Cohen, Yale University, USA
9. Dr Hanif Esmail, MRC Clinical Trials Unit, University College London, UK
10. Prof. Katherine Fielding, London School of Hygiene & Tropical Medicine, UK
11. Dr Emily Web, London School of Hygiene & Tropical Medicine, UK
12. Prof. Pete Dodd, University of Sheffield, UK
13. Prof. Mia Crampin, University of Glasgow UK, and Malawi Epidemiology and Intervention Research Unit, Malawi

Neglected and Tropical Diseases - Janelisa

1. Prof. Enock Matovu, Co-investigator TrypanoGen: The genetic Determinants of Two Neglected Tropical Disease project, COVAB, Uganda
2. Prof. Russell Stothard, Co-Investigator, Hybridisation in urogenital schistosomiasis (HUGS), Liverpool School of Tropical Medicine, UK
3. Prof. Dieuodonne Mumba, Co-investigator TrypanoGen: The genetic Determinants of Two Neglected Tropical Diseases project, INRB, Kinshasa, DR Congo
4. Prof. Mathurin Koffi, Co-investigator TrypanoGen: The genetic Determinants of Two Neglected Tropical Diseases project, Jean Lolognon Guede University, Côte d'Ivoire
5. Dr Gustave Simo, Co-investigator TrypanoGen: The genetic Determinants of Two Neglected Tropical Diseases project, University of Tchong, Cameroon
6. Dr Vincent P Alibu, Collaborator TrypanoGen: The genetic Determinants of Two Neglected Tropical Diseases project, CONAS, Uganda
7. Dr Annette Macleod, Co-investigator TrypanoGen: The genetic Determinants of Two Neglected Tropical Diseases project, University of Glasgow, UK
8. Dr Bruno Bucheton, Collaborator TrypanoGen: The genetic Determinants of Two Neglected Tropical Diseases project, Institut de Recherche pour le Développement (IRD), France
9. Prof. Christianne Hertfowler, Collaborator TrypanoGen: The genetic Determinants of Two Neglected Tropical Diseases project, University of Liverpool, UK
10. Dr Joe Turner, Liverpool School of Tropical Medicine, UK
11. Dr Kyoko Hayashida, Hokkaido University, Japan

Paediatrics and Child Health

1. Robert Bandsma, Mechanisms of infant malnutrition, The Hospital for Sick Children, Toronto, Canada
2. Marko Kerac, Health policy and infant malnutrition, London School of Hygiene & Tropical Medicine, UK

3. Jonathan Wells, Body composition and infant malnutrition, University College London, UK
4. Ken Maleta, Infant malnutrition studies, KUHeS, Malawi
5. Mia Crampin, Generation Malawi Birth Cohort CI, MEIRU, Malawi
6. Duolao Wang, Statistician on clinical trials, Liverpool School of Tropical Medicine, UK
7. Pablo Rojo, EMPIRICAL trial CI
8. Chris Buck, Empirical pharmacy sub-study collaborator, UCLA, USA
9. John Tembo, Empirical respiratory sub-study collaborator, University of Zambia, Zambia
10. Neil French, Paediatric pneumonia studies, University of Liverpool, UK
11. Todd Swarthout, Paediatric pneumonia studies, MLW, Malawi
12. Rob Heyderman, Paediatric pneumonia studies, University College London, UK

Infectious Disease Epidemiology

1. Dr Emanuele Giorgi and Prof. Peter Diggle, Geospatial epidemiology, CHICAS, Lancaster University, UK
2. Prof. Feiko Ter Kuile, Treatment optimisation and malaria surveillance, Liverpool School of Tropical Medicine, UK
3. Dr Sammy Khagayi and Dr Simon Kariuki, Mathematical modelling, KEMRI-CGHR, Kenya
4. Prof. Thumbi Mwangi, Mathematical modelling, Centre for Epidemiological Modelling and Analyses, University of Nairobi, Kenya
5. Prof. Karen Barnes, Treatment optimisation and supervisor Clifford Banda PhD, University of Cape Town (UCT), South Africa
6. Prof. Jacky Snoep and Prof. John Hargrove, Mathematical modelling, SACEMA, University of Stellenbosch, South Africa
7. Dr Lucy Okell, Dr Patrick Walker, Prof. Azra Ghani, Mathematical modelling, Malaria modelling group, Imperial College London, UK
8. Prof. Neil French, Malaria vaccine phase IV, University of Liverpool, UK

9. Prof. Ken Maleta, Prof. Don Mathanga, Prof. Victor Mwapasa and Dr Linda Nyondo-Mipando, Malaria vaccine phase IV, Implementation research/ Knowledge translation, Kamuzu University of Health Sciences, Malawi
10. Prof. Rob Heyderman, University College London, UK
11. Prof. Joel Tarning, collaborator malaria clinical pharmacology, MORU Tropical Health Network, Oxford University, Bangkok, Thailand
12. Frédéric Debollut, Clint Pecenta, Center for Vaccine Innovation and Access, PATH, Geneva, Switzerland and Seattle, USA
13. Dr Nicolas Praet, GSK, Wavre, Belgium, CI of the Malaria vaccine phase IV programme (EPIMAL) and the PIs across the 7 sites in Ghana, Kenya and Malawi.
14. Prof. Shabir Madhi, Witwatersrand University. CI of the GAVI COVID-19 vaccine safety surveillance programme and the PIs across the 8 sites in Mali, Ghana, Nigeria, Mozambique, Kenya, Eswatini, Ethiopia, Malawi.

Pneumonia and Meningitis Pathogens

1. Prof. Robert Heyderman, Senior Investigator and active advisor to the Group's work portfolio, NIHR Mucosal Pathogens Research Unit (MPRU), Division of Infection and Immunity, University College London, UK
2. Prof. Neil French, Senior Investigator and active advisor to the Group's work portfolio, Center for Global Vaccine Research, Institute of Infection & Global Health, University of Liverpool, UK
3. Prof. Sunetra Gupta, Leads a team of mathematical modellers currently working to model dynamics of pneumococcal carriage and transmission, Department of Zoology, University of Oxford, UK
4. Prof. Peter Diggle, Co-investigator leading a team of statistical modellers supporting analysis of pneumococcal carriage surveillance data, The Centre for Health Informatics, Computing, and Statistics (CHICAS), Lancaster Medical School, Lancaster University, UK

5. Prof. Ken Maleta, Co-investigator and advisor for the Group's work portfolio in Mangochi District, University of Malawi College of Medicine, Malawi
6. Prof. Shabir Madhi, Advisor, University of the Witwatersrand/Medical Research Council/National Institute for Communicable Diseases Respiratory and Meningeal Pathogens Research Unit, South Africa
7. Prof. David Goldblatt, Co-investigator and advisor on serological outputs, Institute of Child Health, University College London, UK
8. Prof. Victor Mwapasa, Member of the PAVE Expert Advisory Committee, University of Malawi College of Medicine, Malawi

Infection and Immunity

1. Dr Annie Mwale-Chauma and Dr Watipaso Kasambara, Collaborating on multi-disease serosurveillance in Malawi, Public Health Institute of Malawi, Malawi
2. Prof. Victor Mwapasa, Prof. Arox Kamng'ona, Dr Benjamin Kumwenda and Dr Tonney Nyirenda, Collaborating on pneumococcal and SARS-CoV-2 studies, Malawi
3. Dr Zaza Ndhlovu, Collaborating on HIV and SARS-CoV-2 studies, Africa Health Research Institute, South Africa
4. Prof. Shabir Madhiand, Dr Gaurav Kwatra, Collaborating on SARS-CoV-2 studies, University of the Witwatersrand, South Africa
5. Prof. Daniela Ferreira, Collaborating on studies investigating pneumococcal carriage and infection, Liverpool School of Tropical Medicine, UK
6. Prof. Robert Heyderman, Collaborating on pneumococcal and SARS-CoV-2 studies, University College London, UK
7. Prof. David Russell, Collaborating on studies investigating TB and HIV infection in the lung, Cornell University, USA
8. Dr Brenda Kwambana-Adams, Collaborating on pneumococcal studies, University College London, UK
9. Prof. Stephen Bentley and Dr Chrispin Chaguzza, Collaborating on pneumococcal genomics, Wellcome Sanger Institute, UK
10. Prof. David Goldblatt, Collaborating on serology, University College London, UK

11. Prof. Mia Crampin and Dr Abena Amoah, Collaborating on multi-disease serosurveillance in Malawi, London School of Hygiene & Tropical Medicine, UK
12. Dr Antonia Ho, Collaborating on multi-disease serosurveillance in Malawi, University of Glasgow, UK
13. Dr Kristin Scheible, Co-investigator on a study investigating microRNA expression in neonatal T cells, University of Rochester, USA
14. Dr Brian Rudd, Co-investigator on a study investigating microRNA expression in neonatal T cells, Cornell University, USA

Clinical and Laboratory Malaria

1. Dr Gretchen Birbeck, Aggressive anti-pyretics in CNS malaria, University of Rochester, USA
2. Dr Douglas Postels, Treating brain swelling in severe malaria, Children's National, USA
3. Dr Nicole O'Brien, Treating brain swelling in severe malaria, Nationwide Children's Hospital, USA
4. Dr Miriam Laufer, The intransigence of malaria in Malawi, University of Maryland, USA
5. Dr Peter Lillehoj, Rapid in-field malaria diagnosis, prognosis and monitoring using a mobile phone, Rice University, USA
6. Dr Michael Griffiths, Childhood aetiologies of severe encephalopathy, University of Liverpool, UK
7. Dr Nicholas Beare, Predicting acute and post-recovery outcomes in cerebral malaria by optical coherence tomography, University of Liverpool, UK
8. Prof. Matt Marti, Identifying sequestration sites of malaria transmission stages in vivo, University of Glasgow, UK
9. Dr James Brewer, Neutrophils in Cerebral Malaria (NCEMA), University of Glasgow, UK
10. Prof. Stephen Rogerson, Plasmodium falciparum erythrocyte membrane protein 1: Identifying the targets and functional characteristics of antibody response, University of Melbourne, Australia
11. Dr Kami Kim, Characterization of Plasmodium falciparum var/PfEMP1 type and immune response to PfEMP1 in severe and uncomplicated clinical malaria, University of South Florida, USA

12. Dr Audrey Odom John, Towards a "malaria breathalyzer": Validation of breath biomarkers, Children's Hospital of Philadelphia, USA
13. Dr Vinyak Joshi, Hand-held cameras for the rapid diagnosis of malaria retinopathy, VisionQuest, USA
14. Prof. Andy Waters, Single cell interrogation of the blood-brain barrier in human cerebral malaria: a translational approach, University of Glasgow, UK
15. Dr Thomas Otto, Single cell interrogation of the blood-brain barrier in human cerebral malaria: a translational approach and Neutrophils in Cerebral Malaria, University of Glasgow, UK
16. Dr Aubrey Cunnington, The role of neutrophils in malaria pathogenesis, Imperial University, UK
17. Dr Nathan Schmidt, Gut microbiota and human malaria, Indiana University School of Medicine, USA
18. Dr Borko Amulic. Neutrophils in Cerebral Malaria (NCEMA), University of Bristol, UK
19. Kevin Couper. High dimensional imaging in the brain and spleen in cerebral malaria and investigation of the Inflammasome in cerebral malaria, University of Manchester, UK

Early Life Infection

1. Kirsty le Doare, PREPARE perinatal network – collaboration on PeriCOVID (EDCTP) and WHO perinatal COVID protocol (Dr Freyne) and PREPARE GBS Sero-epidemiology study (Dr Nielsen), St George's University London, UK
2. Naor Bar-Zeev, Co-applicants on three large multi-site RCTs for the reduction of pediatric mortality in LMICs in 2019 (Dr Freyne), Johns Hopkins University, USA
3. Wieger Voskujil, Co-applicant on WHO invited trial of infant supplementary feeding May 2020, University Medical Centre, Amsterdam, The Netherlands
4. Marco Kerac, Co-supervisor ChroSAM follow-up study, London School of Hygiene & Tropical Medicine, UK
5. Melisa Gladstone, Co-supervisor on ChroSAM study, University of Liverpool, UK
6. Neil French, Supervisor Dr Nielsen, CI PREPARE study, University of Liverpool, UK
7. Enitan Carroll, Supervisor Dr Nielsen, University of Liverpool, UK

8. Nigel Cunliffe, Co-investigator ABCD trial, University of Liverpool, UK
9. Michael Marks, Collaborator on the Syph_STAT project, London School of Hygiene & Tropical Medicine, UK
10. Mia Crampin, Collaborator on the DIPLOMATIC project and the Syph_STAT project, University of Glasgow, UK and Malawi Epidemiology and Intervention Research Unit, Malawi
11. Nigel Curtis, Collaborator and co-applicant on multi-site trial of BCG for reduction of mortality in LMICs, University of Melbourne, Australia
12. Steve Graham, Collaborator on methods of operational research to measure the COVID-19 response at Queen Elizabeth Children's Hospital, University of Melbourne, Australia
13. Mike English, Collaborator and advisor on the development of a learning system for maintenance of in-patient quality of care at Queen Elizabeth Children's Hospital, University of Oxford, UK

Vector Biology

1. Luigi Sedda, Collaborator on WT Seed Award and application of modelling wind data on malaria infection, Lancaster University, UK
2. Michelle Stanton, Co-Investigator, co-supervisor and collaborator on spatial technologies for mosquito surveillance, Liverpool School of Tropical Medicine, Liverpool, UK
3. Steve Torr, Collaborator and co-Investigator on the design of tsetse fly fieldwork in Vwaza, Liverpool School of Tropical Medicine, Liverpool, UK
4. Frances Hawkes, Collaborator and advisor on mosquito trap development, University of Greenwich, UK Annette MacLeod, Co-investigator into trypanosome dynamics in Vwaza Marsh, University of Glasgow, UK
5. Rose Oranje, Policy analysis for Shire-Vec, AFIDEP
6. Jennifer Lord, Tsetse fly population dynamics, Liverpool School of Tropical Medicine, Liverpool, UK
7. Federica Guglielmo, Ethnography research in Lower Shire Valley, Liverpool School of Tropical Medicine, Liverpool, UK

8. Anne Wilson, Vector control in the Lower Shire Valley, Liverpool School of Tropical Medicine, Liverpool, UK

Lung Health

1. Dr Tim Baker, Co-investigator on ARCS and other projects, and collaborator on clinical audit and research in critical care / HDRU development), London School of Hygiene & Tropical Medicine, UK
2. Prof. Daniela Ferreira, Ongoing CHIM collaborator (key MARVELS link), Liverpool School of Tropical Medicine, UK
3. Prof. Jonathan Grigg, Chief Investigator for ACACIA studying asthma in children in Africa, Queen Mary University London, UK
4. Dr Shevin Jacob, Co-director of NIHR Sepsis Group (ARCS), Liverpool School of Tropical Medicine, UK
5. Dr Elizabeth Joeques, Supports ARCS and many other projects, including ultrasound capacity building in COM/QECH) especially CT and ultrasound, University of Liverpool and Liverpool School of Tropical Medicine, UK
6. Prof. Maiwenn Kersaudy-Kerhoas, Bioengineering collaborator on near-patient diagnostics of infection aetiology, Heriot-Watt University, UK
7. Prof. Bruce Kirenga, Long-time co-investigator on chronic lung disease, including pulmonary rehabilitation, and key South-South partner (Uganda-Malawi), Makerere University, Uganda
8. Prof. Kevin Mortimer, Continues to support asthma dissemination work with Beatrice Chinoko, Liverpool School of Tropical Medicine, UK
9. Dr David Oxborough, Collaborator on echocardiographic findings in sepsis, Liverpool John Moores University, UK
10. Dr Elizabeth Riviello, Chief Investigator on High Flow Humidified Nasal Oxygen RCT (BREATHE), Beth Israel Deaconess Medical Center and Harvard Medical School, USA
11. Dr Matt Rubach, Co-investigator for Multilink, KCMC Kilimanjaro, Tanzania
12. Dr Hendry Sawe, Co-investigator for Multilink, Muhimbili University of Health and Allied Sciences, Tanzania

13. Prof. Tom van der Poll, Collaborator on transcriptomics in sepsis, UMC Amsterdam, Netherlands

14. WHO O2CoV2 research group, WHO, Geneva, Switzerland

15. Dr Joost Wiersinga, Collaborator on transcriptomics in sepsis, UMC Amsterdam, Netherlands

Genomic Epidemiology & Antimicrobial Resistant Microbes (GEARM)

1. Prof. Eric Houpt, Aetiology of diarrhoea, University of Virginia, USA
2. Dr Naor Bar-Zeev, Shigella surveillance, John Hopkins University, USA
3. Prof. Stephen Bentley, Global Pneumococcal Sequencing Project, Wellcome Sanger Institute, UK
4. Mrs. Watipaso Kasambara, AMR focal contact, Ministry of Health, Malawi
5. Prof. Nigel Cunliffe, Dr Mike Griffiths, Prof. Kate Baker, Prof. Nicola Williams, Prof. Tom Solomon and Prof. Jay Hinton, multiple projects, Institute of Infection and Global Health, University of Liverpool, UK
6. Dr Eva Heinz, Genetic epidemiology of Gram-Negative bacteria, Liverpool School of Tropical Medicine, Liverpool, UK

Biostatistics Associate Research Group

1. D. O'Connor, HIC-Vac project, Using machine learning to identify a transcriptomic gene signature discriminating between bacterial, viral and malaria infections, Oxford Vaccine Group, University of Oxford, UK
2. E. Giorgi, CHICAS, Hepatitis D systematic review and J. Khaki co-supervisor, Lancaster University, UK
3. C. Jewell, CHICAS and J. Khaki co-supervisor, Lancaster University, UK
4. P. Diggle, CHICAS, annual unit review panel member, Lancaster University, UK
5. G. Leday, OptiVaNTS grant network modelling, MRC BSU, Cambridge University, UK
6. D. Wang, LSTM tCTU providing support for larger multi-site trials; similar collaboration with the University of Liverpool, UK Clinical Trials Centre, Liverpool School of Tropical Medicine, UK

7. M. Mukaka, Supervision of PhD student J. Khaki, sharing of training materials, Mahidol Oxford Tropical Medicine Research Unit (MORU), Thailand

8. J. Orbinski, Complex adaptive modelling of climate change health impacts in Malawi collaboration & training, York University, Canada

9. B. Quilty and S. Flasche, Spatiotemporal dynamics of pneumococcal carriage in Blantyre, Malawi project, London School of Hygiene & Tropical Medicine, UK

10. Rachel Lowe, Mentorship to J. Chirombo fellowship, Barcelona Supercomputing Center, Barcelona, Spain

11. T. Smith, KUUNIKA follow-on project, Cooper / Smith, Malawi

Medicine and Society

1. Prof. Clare Chandler, FIEBRE, London School of Hygiene & Tropical Medicine, UK
2. Dr Anne Katahoire, Makerere University, Uganda
3. Dr Tracy Morse, Exploring the impact of COVID-19 on health care provision, University of Malawi, Polytechnic, Malawi

Gender in Health

1. Prof. Elizabeth Corbett, UK-Mentor, London School of Hygiene & Tropical Medicine, UK
2. Prof. David Lissauer, Co-investigator - FAST-M+, MLW, Malawi, and University of Liverpool, UK
3. Prof. Bertie Squire, International co-investigator DFID LIGHT Grant, Liverpool School of Tropical Medicine, UK
4. Prof. Melanie Abas, International co-investigator, MRC Tendai Grant, University College London, UK
5. Dr Nicola Desmond, Co-investigator and UK mentor, Liverpool School of Tropical Medicine, UK
6. Dr Eleanor MacPherson, Co-investigator, Malawi Liverpool Wellcome Trust, Malawi
7. Dr Debora Nyirenda, Co-investigator, Malawi Liverpool Wellcome Trust, Malawi
8. Prof. Miriam Taegtmeier, Co-supervisor and mentor, Liverpool School of Tropical Medicine, UK

9. Dr Peter MacPherson, Liverpool School of Tropical Medicine, UK

10. Dr Augustine Choko, Co-Investigator, Malawi Liverpool Wellcome Trust, Malawi

11. Dr Marriot Nliwasa, HNTI, Kamuzu University of Health Sciences, Malawi

12. Dr Chisomo Msefula, Kamuzu University of Health Sciences, Malawi

13. Dr Jeremiah Chikovore, International co-investigator, Human Sciences Research Council, South Africa

14. Dr Louisa Afran, Co-Investigator, Malawi Liverpool Wellcome Trust, Malawi

15. Prof. Dickson Chibanda, Co-investigator, University of Zimbabwe, London School of Hygiene & Tropical Medicine, Zimbabwe

16. Dr Euphemia Chibanda, Co-investigator, CECCHAR, Zimbabwe

17. Dr Musonda Simwinda, Co-investigator, ZAMBART, Zambia

18. Dr Mariam Otmani Del Barrio, TDR WHO, Switzerland

19. Dr Elena Ivanova Reipold, Co-investigator, FIND, Switzerland

20. Dr Rebecca Jopling, Co-Investigator, Kings College London, UK

Community Engagement and Bioethics

1. Prof. Michael Parker, Global Health Bioethics Network, Ethox Centre-University of Oxford, UK
2. Prof. Patricia Kingori, Global Health Bioethics Network, Ethox Centre-University of Oxford, UK
3. Prof. Melita Gordon, University of Liverpool, UK and MLW, Malawi
4. Prof. Victor Mwapasa, Kamuzu University of Health Sciences, Malawi
5. Prof. Mia Crampin, MEIRU, Malawi and University of Glasgow, UK
6. Dr Nicola Desmond, Liverpool School of Tropical Medicine, UK
7. Dr Chris Moxon, University of Glasgow, UK, and MLW, Malawi
8. Dr Eleanor MacPherson, Liverpool School of Tropical Medicine, UK, and MLW, Malawi

HIV and Tuberculosis (TB) - MLW and KUHES

1. Prof. Liz Corbett, Capacity Building for TB research in Malawi: the Helse Nord TB initiative, London School of Hygiene & Tropical Medicine, UK
2. Prof. Martin Boeree, Consortium for TB drug development (PanACEA-TB), Radboud University Medical Center, The Netherlands
3. Dr Heinrich Norbett, consortium for TB diagnosis in children (RaPaed), University of Munich, Germany
4. Dr Derek Sloan, Genetic basis of persistence of Mycobacterium tuberculosis, University of St Andrews, UK
5. Prof. Jon Odland, Capacity Building for Clinical Research in Malawi, Norwegian University of Sciences and Technology, Norway
6. Dr Stella Mpagama, Capacity Building for TB research in Africa through TB therapeutic trials, Kilimanjaro Clinical Research Institute, Tanzania
7. Dr Wilber Sabiiti, Host-responses to TB disease and treatment, University of St Andrews, UK

Implementation Research in Health (IRH)

1. Prof. Liz Corbett, Long-term TB epidemiology and trials collaborator, London School of Hygiene & Tropical Medicine, UK
2. Assoc. Prof. Stephane Helleringer, Social networks and demography, Johns Hopkins University, USA
3. Prof. Katherine Fielding, Statistician, London School of Hygiene & Tropical Medicine, UK
4. Prof. Nigel Stallard, Statistics, University of Warwick, UK
5. Prof. Amaya Bustinduy, Schistosomiasis, London School of Hygiene & Tropical Medicine, UK
6. Prof. Nigel Stothard, Schistosomiasis, Liverpool School of Tropical Medicine, Liverpool, UK
7. Assoc. Prof. Donaldson Conserve, The George Washington University, USA
8. Ms Cheryl Johnson, World Health Organization, Geneva, Switzerland

Appendix B - Postdocs and postgraduate students, graduated or completed in 2021

Mucosal and Vascular Immunology

Dr David Mzinza	Post-Doctoral Research Associate, MLW
Dr Dumizulu Tembo	Post-Doctoral Research Associate, MLW
Dr Katharine Stott	Wellcome Clinical PhD fellow, University of Liverpool, <i>Mechanisms and pharmacodynamics of antifungal agents for cryptococcal meningitis</i> , graduated
Tinashe Nyazika	PhD fellow, Liverpool School of Tropical Medicine, <i>Cellular immune responses against Streptococcus pneumoniae in the human lung</i> , graduated
Aaron Chirambo	MSc, University of Glasgow, graduated
Gloria Mwangalika	MSc, University College London, graduated
Dr Vanessa Kandoole-Kabwere	MMed Internal Medicine, University of Malawi College of Medicine, completed. Undergoing postgraduate clinical training at University Hospitals Bristol NHS Foundation Trust, UK
Dr Alinane Munyenembe	MSc, University of Glasgow, graduated. Undergoing postgraduate clinical training at Aberdeen Royal Infirmary, UK
Dr Melanie Alufandika-Moyo	MMed Internal Medicine, University of Malawi College of Medicine, Assessing mortality differences among ART-experienced patients with HIV-associated cryptococcal meningitis in AMBITION-cm trial, completed

Bacterial and Drug Resistant Infection

Dr Rebecca Lester	Wellcome Clinical PhD fellow, Liverpool School of Tropical Medicine, <i>Antimicrobial Resistance Study to Determine Outcomes and Transmission of ESBLs in Blantyre (AntiDOTE)</i> , graduated
Melodie Sammarro	PhD fellow, University of Lancaster, Supervisors: C Jewell/B Rowlingson/N Feasey, British, PhD thesis submitted December 2021
Dr Sam Lissauer	PhD, Consultant in Paediatric Infectious Diseases, University of Liverpool
Lucky Ngwira	PhD submitted November 2021, Health Economist, COVID-ES

Salmonella and Enterics

Dr Philip Ashton	Lead Bioinformatician, MLW
Dr Alexander Stockdale	PhD, University of Liverpool, Hepatitis B and C in Malawi: Epidemiology, Disease Burden and Assessment of Treatment Eligibility, passed
Dr James Meiring	DPhil, University of Oxford, The burden of typhoid fever in Malawi, passed
Happy Banda	MSc Bioinformatics, University of Malawi College of Medicine, <i>Investigating gut microbiota profiles associated with Enterovirus shedding in Malawian healthy children</i> , completed
Dr Fumbani Limani	MMed Internal Medicine, University of Malawi College of Medicine, completed
Dr Pratiksha Patel	PLAB 1&2 passed, specialist clinical training in the UK

Virology

- Dr Kayla Barnes** NIH Fogarty K-fellow, Harvard School of Public Health (based at MLW), carried out her PhD at the Liverpool School of Tropical Medicine where she studied the genetic causes of insecticide resistance. Kayla carried out her postdoc at the Broad Institute of MIT and Harvard with Pardis Sabeti where she focuses on evolutionary genetics of viral haemorrhagic fever. Kayla currently is determining transcriptomic signatures of rotavirus vaccine failure
- Dr Isaac Thom Shawa** Post-Doctoral Research Associate bridging fellowship, obtained his PhD *Protection from HCV Resistance; Identification of mechanisms to HCV infection in exposed uninfected injection drug users*, University of Plymouth, December 2017. He is currently characterizing rotavirus-specific B cell responses in under-five Malawian children presenting with rotavirus diarrhoea
- Dr Arox Kamng'ona** Post-Doctoral Research Associate, obtained his PhD at the University Liverpool in the UK jointly with the University of Malawi in Malawi in 2014 where he studied the Nasopharyngeal Carriage Dynamics of *Streptococcus pneumoniae* and other Microbiota in Malawian Children and Adults. He is investigating human microbiomes and impact on human health in resource poor African settings
- Jonathan Mandolo** MSc, University of Malawi, College of Medicine, *Association between maternal breast milk microbiota and infants' gut microbiota profiles and their relationship to rotavirus vaccine response in Malawian children*, completed
- Chifundo Salif** MSc, University of Malawi, College of Medicine, *The antimicrobial activities of selected local medicinal herbs against Streptococcus pneumoniae*, completed
- Happy Banda** MSc, University of Malawi, College of Medicine, *Investigating gut microbiota profiles associated with enterovirus shedding in Malawian Children*, completed

Maternal and Fetal Health

- Dr Charlotte Van Der Veer** Post-Doctoral Research Associate, University of Liverpool
- Dr Louise Afran** Post-Doctoral Research Associate, University of Liverpool
- Dr Maria Odland** Tenure Track Fellow, University of Liverpool
- Catherine Dunlop** PhD, University of Birmingham, *The prevention of maternal sepsis in global settings*, completed
- Dr Emma Kinghan** MSc International Public Health, Liverpool School of Tropical Medicine, *Factors influencing acceptance of oxygen therapy in QECH Malawi: A qualitative analysis of attitudes and understanding of adult patients and health care professionals*, completed
- Dr Emilie Marcher** MSc International Public Health, Liverpool School of Tropical Medicine, *Building therapeutic alliances between carers and medical teams: how much do perceptions differ on the causes and treatment of complicated severe acute malnutrition? A qualitative study in Blantyre, Malawi*, completed
- Dr Edward Monk** MSc Epidemiology, London School of Hygiene and Tropical Medicine, Case finding programmes for tuberculosis and their impact on knowledge, attitudes and health-seeking practices; a formative evaluation in Blantyre, Malawi, completed
- Jotham Nyasulu** MSc Public Health, University of Malawi College of Medicine, *Can HIV Diagnostic Assistants address Human Resources challenges? – Examining the role task-shifting of HIV service provision in Nkhotakota District, Malawi*, completed

- Lisa Harrison** MSc International Public Health, Liverpool School of Tropical Medicine, *You have a self-testing method that preserves privacy, so how come you cannot give us treatment that does too? Identifying the barriers and facilitators for young people linking to health facilities after HIV Self-Testing in Southern Malawi, Machinga*, completed

Public Health

- Dr Augustine Choko** Post-Doc (Wellcome Intermediate Fellowship) and Associate Group Head (Implementation Research in Health), MLW, *Creating demand for fishermen's schistosomiasis and HIV services*
- Dr Marriott Nliwasa** Post-Doc & Associate Group Head (Helse Nord TB Programme), College of Medicine, University of Malawi, Helse Nord TB Programme
- Dr Titus Divala** PhD, (Commonwealth Scholar & Helse Nord Fellowship), London School of Hygiene & Tropical Medicine, *Benefits versus risks of using empirical treatment with broad-spectrum antibiotics in TB diagnostic algorithms*, graduated
- Peach Indravudh** PhD, London School of Hygiene and Tropical Medicine, *HIV self-testing in the STAR Project*, graduated
- Dr Madalo Thindwa** MSc Epidemiology, London School of Hygiene and Tropical Medicine, *Chest x-ray and urine-based screening for tuberculosis in Blantyre, Malawi*, completed
- Rebecca Nzana** MSc Epidemiology, London School of Hygiene and Tropical Medicine, *Relationship between HIV status and reported TB testing in Blantyre, Malawi*, completed
- Andrew Moseray** MPH, Liverpool School of Tropical Medicine, completed
- Wala Kamchedzera** Msc, London School of Hygiene and Tropical Medicine, *The long-term impact of implementing a facility-based TB screening intervention based on computer aided chest x-ray diagnosis in Malawi*, completed

Neglected Tropical Diseases

- Dr Seke Kayuni** Post-Doctoral Research Associate, Liverpool School of Tropical Medicine, *Hybridisation in urogenital schistosomiasis*
- Dr Gabriel Bunduki** MSc AMR, University of Malawi College of Medicine, *Healthcare-Associated Urinary Tract Infection among Patients Admitted in Surgery Department at Queen Elizabeth Central Hospital: Risk Factors and Antimicrobial Resistance Profile*, completed
- Dieckens Binali** Msc AMR, University of Malawi College of Medicine, *Determinants of Antimicrobial Use in Diarrhoea Management among Under-Five Children in Zomba, Malawi*, completed

Paediatrics and Child Health

- Dr Frank Phoya** MMed Paediatrics, University of Malawi College of Medicine, *Risk factors associated with hypothermia among neonates*, completed
- Dr Mphatso Chisala** pre-PhD, MLW, *Dietary intake assessment of children with cryptosporidium and stunting*, completed
- Dr Grace Mzumara** pre-PhD, MLW, *Antimicrobial stewardship in least developed countries*, completed
- Mike Mambiya** pre-PhD, MLW, *Evaluating the differences in Energy, Macronutrient and Micronutrient Composition of Human Milk in Rural and urban mothers and influence on infant's growth in Lilongwe, Malawi*, completed

Adwoa Ohemeng Owusu	MSc, Liverpool School of Tropical Medicine, <i>Probiotics and neurodevelopmental outcomes in neonates: a systematic review</i> , completed
Omar Akhtar	MSc, Liverpool School of Tropical Medicine, <i>Probiotics and antimicrobial resistance among neonates and children: a systematic review</i> , completed
Olutobi Ojuawo	MIPH, Liverpool School of Tropical Medicine, <i>Diagnostics in children hospitalized with acute respiratory infection</i> , completed
Dr Victoria Mukhula	pre-MSc, MLW, <i>Linear growth and association with resting energy expenditure and stool Cryptosporidium in children after diarrhoea hospitalisation</i> , completed
Dr Dominic Moyo	<i>Respiratory virus infections in hospitalised children in sub-Saharan Africa including COVID-19: a systematic review</i> , completed
Prisca Harawa	<i>Clinical characteristics and outcomes of malnourished children with bloodstream infections at QECH, Malawi</i> , completed
Natasha Banda	<i>Impact of early intervention for cerebral palsy</i> , completed
Harrison Sikilamwa	MPH, University of Malawi College of Medicine, <i>Evaluating the acceptability and feasibility of a health passport insert for improving documentation of syphilis treatment in pregnancy</i> , completed
Zacharia Kafuwa	MPH, University of Malawi College of Medicine, <i>Determining bottlenecks in the coverage and quality of services for mother to child transmission of syphilis in Malawi</i> , completed
Naomi Mkutche	MPH, University of Malawi College of Medicine, <i>Evaluating the acceptability of self-testing in antenatal care in the management of mother to child transmission of syphilis</i> , completed
Kondwani Kaunda	MPH, University of Malawi College of Medicine, <i>Evaluating the acceptability and feasibility of written partner notification in the management of mother to child transmission in syphilis</i> , completed
Dr Elias Phiri	pre-MSc Intern, MLW, <i>Pilot Implementation of a multi-faceted COVID-19 response at the department of paediatrics, Queen Elizabeth Central Hospital (QECH) in Blantyre, Malawi</i> , completed

Infectious Disease Epidemiology

Dr Pearson Nkhoma	Post-Doctoral Research Associated, <i>Dynamics of healthcare utilization linked to the RTS,S/AS01 Vaccine Introduction</i>
Dr James Chirombo	Post-Doctoral Research Associate, Statistical Support Unit, MLW. Participates in research collaborations with Malaria Epidemiology group, active
Melody Sakala	pre-PhD (post-MSc research as part of WT Intl MSc fellowship), MLW, <i>Baseline assessment of the Evidence Informed Decision-making Network in Malawi (EVIDeNt) using social network analysis and a prospective case study</i> , completed
Dr Mphatso Phiri	pre-PhD (post-MSc research as part of WT Intl MSc fellowship), MLW, <i>Cost of community-led larval source management and house improvement for malaria control: a cost analysis within a cluster-randomised trial in a rural district in Malawi</i> , completed
Dr Clifford Banda	MMED clinical pharmacology, (EDCTP career development Fs) University of Cape Town, with research component supported by an MLW pre-PhD research internship), graduated
Latif Ndeketa	DBL MSc in epidemiology (MLW Core Scholarship), London School of Hygiene and Tropical Medicine, UK, graduated

Dr Phatisan Bango	Pre-MSc Intern vaccine epidemiology, Supervisors: Terlouw/Ndeketa, completed
Dr Dumisile Nkosi	Pre-MSc Intern Vaccinology and Drug Development, Supervisors: Terlouw/Banda, Malawian, completed

Pneumonia and Meningitis Pathogens

Jacqueline Msefula	MSc in Antimicrobial Stewardship, Supervisor: T Nyirenda, Malawian, Completed
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Infection and Immunity

Dr Dumizulu Tembo	Post-Doctoral Research Associate
Dr Louise Afran	Post-Doctoral Research Associate
Dr David Mzinza	Post-Doctoral Research Associate, 2018
Tinashe Nyazika	PhD, Liverpool School of Tropical Medicine, Cellular immune responses against Streptococcus pneumoniae in the human lung, graduated
Joseph Phiri	MSc, University of Glasgow, graduated
Leonard Mvaya	MSc, London School of Hygiene and Tropical Medicine, graduated
Dr Alinane Munyenembe	MSc, University of Glasgow, graduated. Undergoing postgraduate clinical training at Aberdeen Royal Infirmary, UK

Clinical and Laboratory Malaria

Monica Soko	pre-MSc intern, MLW, completed
Dr Innocent Sulani	pre-MSc intern, MLW, completed. Currently studying MSc Immunology and inflammatory Diseases at the University of Glasgow (Beit Trust Postgraduate Scholarship)
Flora Chirwa	pre-MSc intern, MLW, completed
Priscilla Suleman	pre-MSc intern, MLW, completed
Josephine Banda	pre-MSc intern, MLW, completed
Watipenge Nyasulu	pre-MSc intern, MLW, completed
Thokozile Ngulube	pre-MSc intern, MLW, completed

Early life infection

Elias Phiri	pre-MSc intern, Malawi-Liverpool Wellcome Trust, <i>Pilot Implementation of a multi-faceted COVID-19 response at the department of paediatrics, Queen Elizabeth Central Hospital (QECH) in Blantyre, Malawi</i> , completed
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Vector Biology

Dr Evelyn Olanga	Malaria Alert Centre, PIIVEC Research Career Development Fellow, Mosquito sampling, 2018-2021. Post-Doctoral Research Associate based at MAC and under supervision of Dr Mzilahowa, Dr Jones and Dr Lisa Reimer, Liverpool School of Tropical Medicine, UK, completed
Dr Elizabeth Bandason	Malaria Alert Centre, PIIVEC Research Career Development Fellow, Impact of insecticide-based control on mosquito behaviour and fitness, 2018-2021. Post-Doctoral Research Associate based at MAC and under supervision of Dr Mzilahowa, Dr Jones and Dr Lisa Reimer, Liverpool School of Tropical Medicine, completed

Dr Steve Gowelo Malaria Alert Centre, PIIVEC Research Career Development Fellow, Tsetse fly biology and control, 2019-2021. Post-Doctoral Research Associate based at MAC and under supervision of Dr Mzilahowa, Dr Jones and Dr Steve Torr, Liverpool School of Tropical Medicine, UK, completed

Rhosheen Mthawanji Wellcome MSc fellow, MLW, completed

Amy Withers Lancaster University, NERC Envision, Fall armyworm biology, 2017-2021. PhD student started in the group prior to Dr Jones joining MLW, completed

Lung Health

Dr Felix Limbani Post-doctoral Research Associate, MLW

Dr Ricky Wang Post-doctoral Research Associate, University of California San Francisco (UCSF), USA

Rebecca Nightingale PhD, Liverpool School of Tropical Medicine, Exploring the natural history and determinants of chronic respiratory disease in high-risk populations: perspectives from the UK and Malawi, graduated

Beverly Laher NCD-Brite Asthma Electronic Health, completed

Genomic Epidemiology & Antimicrobial Resistant Microbes (GEARM)

Dr James Jafalai Post-Doctoral Research Associate, MLW/University of Liverpool, H3ABionet

Dr Anmol Kiran Post-Doctoral Research Associate, MLW/University of Liverpool, 2020

Medicine and Society

Wezzie Lora PhD, Liverpool School of Tropical Medicine, *Understanding vulnerability and empowerment through engagement with HIV self-testing among female sex workers in Malawi*, graduated

Victoria Simpson MPH, Liverpool School of Tropical Medicine, *Exploring Antibiotic Prescribing Practice in Urban and Peri-Urban Blantyre, Malawi*, graduated

Alasdair Wood MSc, Liverpool School of Tropical Medicine, *An Exploration of Antibiotic Stewardship in a Low-Income Setting: Factors that shape antibiotic use at Queen Elizabeth University Hospital in Blantyre, Malawi*, graduated

Gender in Health

Wezzie Lora PhD, Liverpool School of Tropical Medicine, *Understanding vulnerability and empowerment through engagement with HIV self-testing among female sex workers in Malawi*, graduated

HIV and Tuberculosis (TB)

Dr Victor Ndhlovu Post-Doctoral Research Associated, Kamuzu University of Health Sciences

Robina Semphere MSc Epidemiology, London School of Hygiene and Tropical Medicine, *Validation of clinical classification of paediatric TB cases by Experts compared to laboratory results*, completed

Dr Hussein Twabi MSc Epidemiology, London School of Hygiene and Tropical Medicine, *Use of digital chest radiography and other features to aid decision stratify patients for shorter TB treatment or standard therapy*, completed

Mable Kisyombe MSc Epidemiology, College of Medicine, *Factors associated with deaths among paediatric TB patients in Malawi: a cross sectional quantitative and qualitative study in Blantyre Malawi*, completed

Dr Lerato Mambulu MMed Medicine, University of Malawi College of Medicine, *Clinical outcomes of adults with suspected meningitis in a high HIV prevalence setting*, graduated

Dr Martin Kamponda MMed Medicine, University of Malawi College of Medicine, *Assessing the Diagnostic Performance of Xpert-Ultra on Extra-Pulmonary Samples for Diagnosis of Disseminated Tuberculosis at Queen Elizabeth Central Hospital*, graduated

Edson Mwinjiwa MPH, University of Malawi, University of Malawi College of Medicine, *Characteristics of patients with suspected meningitis and the role of Xpert MTB/RIF in the diagnosis of TB meningitis among these patients at Queen Elizabeth Central Hospital in Malawi*, graduated

Gabriel Ndhlovu MLW Pre-Masters internship, University of Malawi College of Medicine, *Comparison of three strategies for national roll out of the Gene X-pert MTB/RIF assay to improve diagnosis of TB in Malawi: an operational modelling study*, completed

Implementation Research in Health (IRH)

Dave Chalira MSc, London School of Tropical Medicine and Hygiene, *Investigating couple HIV testing and disclosure proportions by different individual and couple level characteristics, a Secondary Data analysis of Partner-provided Self-testing and Linkage (PASTAL), A multi-arm cluster randomized trial*, completed

Doreen Sakala MSc, Leeds University, *Understanding factors influencing men's involvement in antenatal care including HIV testing: A qualitative study from urban Blantyre, Malawi*, completed