

2018 | 2019

LSTM ANNUAL REPORT



LSTM
LIVERPOOL SCHOOL
OF TROPICAL MEDICINE

Since 1898

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Cover photo: Scientists from LSTM and Tanzania's Vector and Vector Borne-Diseases Research Institute conducting a survey of tsetse in the Tarangire National Park. The research will lead to sustainable strategies to protect people and livestock from sleeping sickness and nagana, diseases caused by trypanosomes transmitted by tsetse flies.

Photo: Steve Torr, LSTM

Vision

To save lives in resource poor countries through research, education and capacity strengthening

Mission

To reduce the burden of sickness and mortality in disease endemic countries through the delivery of effective interventions which improve human health and are relevant to the poorest communities

Values

- Making a difference to health and wellbeing
- Excellence in innovation, leadership and science
- Achieving and delivering through partnership
- An ethical ethos founded on respect, accountability and honesty
- Creating a great place to work and study

Children from Nthumba village in Chikwawa district, Malawi, enjoy playing new games with their teacher. She is one of 25 coaches trained through the Health Goals Malawi project which is using the power of football to bring communities together, using games to spread messages about HIV prevention, and promoting the uptake of HIV self-testing services.

The games have been developed by coaches together with Liverpool Football Club (LFC) Foundation, LSTM, MLW and PSI, to be locally relevant and easy to deliver with a small amount of equipment.

Photo: Lee Booth, LSTM

Chairman's Foreword

This is my twelfth and final foreword to the Annual Report as Chairman. When I arrived in 2007, I brought some knowledge and particularly affection for Liverpool, having chaired Littlewoods. I had an insight into governance and leadership in academia as Chair of the Leadership Foundation for Higher Education and I had lived and done business briefly in sub-Saharan Africa and had some empathy with the complex issues of development in that continent.

My greatest advantage was that I had Janet Hemingway as Director. She had been in place for some 7 years and had turned around a financially challenged institution, got her team in place, and engendered a momentum and sense of direction into LSTM.

Much of my time in the early years with LSTM was taken up in supporting Janet in negotiations with the University of Liverpool, with whom the relationship was at a low ebb, in shaping an alliance with Warwick University, in 'selling' the LSTM story to HEFCE and in determining that the best way for LSTM to continue to grow and fulfil its potential was as an independent Higher Education Institute in its own right. That status was achieved and encouragingly the relationship with the University of Liverpool is now growing closer and more productive.

A decade ago education at LSTM appeared to be the poor relation of research. Now with the grant of degree awarding powers, teaching will play a growing role in fulfilling the mission of LSTM to help break the cycle of poor health and poverty.

LSTM has long been known as Liverpool's best kept secret – and to a great extent that remains true. It will be a challenge for my successor to raise the profile and to build on the foundations in place of an internal communications function and the early successes of our fundraising team.

When I arrived the Board of Trustees was in good shape. That remains true and I am particularly grateful for the support, which trustees have provided. Individually they generously give up a very substantial amount of time to LSTM's business. Although the enterprise is positioned in the sweet spot of international support for public health in resource poor areas, the finances of LSTM remain tight. Large headline research grants do not translate into fat bottom-line results. That LSTM continues to generate small surpluses, while investing in people and buildings without significant borrowings, is a tribute to management and the vigilance of trustees.

One of the most enjoyable parts of my role has been to chair the annual away days, at which trustees come together with about equal numbers of management and concentrate on the formulation of strategy for the period ahead. In a relaxed setting, this has invariably allowed an open and constructive discussion of the challenges facing LSTM.

If I was lucky in inheriting Janet Hemingway as Director, my successor will be spoilt by having David Lalloo as her (or his) Director. David was the unanimous choice of the selection committee, against external competition and is already demonstrating his leadership and his willingness to shape LSTM to the changing world in which we are living. My successor will face many challenges, not least of which will be to conserve but also use constructively the financial strength of the institution, to advocate the excellence of LSTM to external constituencies, to build the momentum of fundraising, to improve the diversity of the Trustee board and of management, to champion the profitable expansion of teaching to complement the continuing excellence in research – and finally to support the Director as he seeks to rebalance LSTM towards the talents and priorities of the countries in which we operate.

Finally, I owe a large debt of gratitude to everyone in LSTM with whom I have worked over the last twelve years. It has been a privilege and great fun. I shall look back with great affection on a very special group of people, doing important work. Thank you.

James H. Ross

James Ross OBE

Director's Foreword

It is a real pleasure and privilege to write my first foreword as Director following another highly successful year for LSTM. Thanks in large part to Janet Hemingway's leadership, I have taken over an organisation at the forefront of global health research with a clear mission and considerable impact in its work in resource poor settings.



That does not mean that there are no challenges. Although LSTM has been well positioned to take advantage of the considerable expansion in global health funding and we continue to grow our research income, the increasing pressures on overheads makes generating surpluses difficult. The political uncertainty over Europe has not only affected funding streams but also has a major influence on the perception of the UK as a place that does not welcome foreigners, something that is both at odds with our culture and highly detrimental to an organisation such as LSTM.

One of our first actions as a management team has been to look forward and consider how we can ensure that LSTM is best equipped to succeed in this changing environment. There is no doubt that we have a group of highly skilled and motivated staff, but we can also do better to ensure working at LSTM is as rewarding as it can be. Reducing our use of fixed term contracts was the beginning of the review of processes and procedures that are aimed at improving working life and attracting and retaining talent in LSTM. This review also addresses issues of equality and diversity, including the gender pay gap. Ensuring robust succession planning is one of our strategic aims and this year has seen the beginning of a specific initiative to recruit junior lecturers. Developing the research leaders of the future will be critical as many of the senior staff who have underpinned LSTM's success move towards retirement.

The scientific environment is also changing. The scientific capacity of many of the countries in which we work is rapidly growing and funding is increasingly flowing directly through those countries. Much of LSTM's success has been built on equitable partnerships but the nature of those partnerships is evolving. Therefore, we need to focus on how we grow the number and breadth of our overseas partnerships to respond to changing needs, ensuring that LSTM becomes an even more international organisation.

It is also an appropriate time to consider our relationship to Liverpool as a city. Our major focus will always be on poor populations in tropical regions. However, as a public health institution it is important to explore how LSTM can use its expertise to better engage with the considerable public health issues that face Liverpool and we must ensure that we take our place alongside other Liverpool institutions as the Life Sciences becomes a major driver for the Liverpool economy.

Finally, it has been an enormous privilege to work with James as the Chair of the Board of Trustees over the last year. I have found his help and advice to be invaluable and I know that Janet felt the same: his wisdom and humanity has helped guide LSTM through some challenging times over the past twelve years. LSTM has been very lucky to have him as our Chair of the Board of Trustees and we wish him the very best for the future.

D Lalloo

Professor David Lalloo

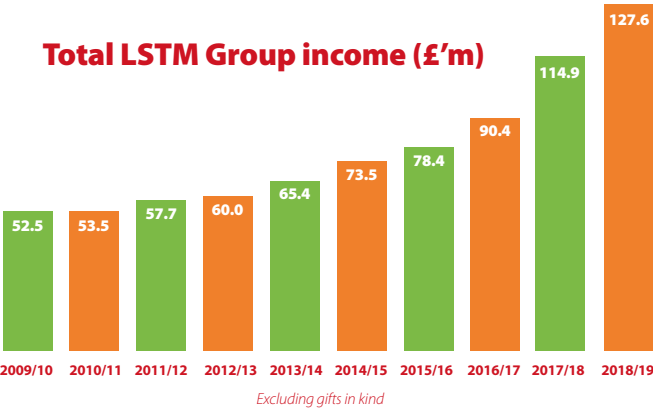
“Much of LSTM's success has been built on equitable partnerships but the nature of those partnerships is evolving”

Treasurer's Report

For the eleventh successive year the LSTM Group is able to report a record level of income. The reported total income exceeded £240m. The surplus on continuing operations (excluding pension deficit funding costs) was £2.98m. Group net assets at the year-end were £39m.



Group income totalled £243m (2018: £232m). This included £115m (2018: £118m) of 'gifts in kind'. The gifts in kind were primarily pharmaceutical drugs relating to a DFID mass drug administration programme in several African countries. Excluding the gifts in kind, LSTM reported total income of £128m (2018: £115m), which represented a 11% increase over the previous year. The increase in income was used to increase our expenditure on research and academic activities.



Our deficit for the year was £11.4m (2018: Surplus £4.3m). As with the prior year, this figure was impacted by some non-recurring items which impacted the reported results. Most significantly, we have been required to record a charge of £15.2m in relation to pension deficit costs. Currently, we expect this figure to substantially reverse in the current financial year.

Excluding this item and other non-operational accounting entries we recorded a surplus of £3.88m (2018: £4.39m), which we consider to be satisfactory.

Group net assets at the year-end totalled £39m (2018: £50m). Again, this was impacted by the pension charge referred to earlier. Excluding deferred capital grants of £26m, which are unlikely ever to be repaid, net assets totalled £65m. The financial condition of LSTM remains healthy.

Equally important is the pipeline of research projects. At the year end, I am pleased to report that LSTM had secured research contracts of £272m (2018: £221m), which have yet to be spent.

Looking ahead, we expect activity levels in the current year to exceed 2018/19.

Finally, we continue to invest in our Estates to accommodate future growth plans both in the UK and overseas. We continue to look at options to ensure that we have the facilities and infrastructure to deliver our services.

Jon Schofield

Jon Schofield BA ACA

“The increase in income was used to increase our expenditure on research and academic activities”

Introduction to the Feature Articles

Partnerships and collaboration are two key principles in our approach to deliver global health solutions. Throughout our long history our translational research cycle has continued to evolve in line with the ever-changing priorities in global health. Through the expertise of our partners and collaborators across the world we have been able to develop relevant solutions with global impact.



Responsible growth and innovation are key to finding and delivering these global health solutions. as exemplified by establishing the Clinical Research Excellence and Training Open Resource (CREATOR) with our partners in Malawi; the Active Learning Laboratory in Liverpool and the Health Innovation in a Virtual Environment (HiVE) in Ghana and beyond. These three initiatives illustrate how we aim to bring together leading and emerging pioneers in global health research and train the next generation of global health leaders.

As we prepare our submission for the forthcoming Research Excellence Framework (REF) 2021 we have made further strategic changes to our research portfolio. Our research themes have been expanded in the areas of HIV and Innovation, Discovery and Development, while other themes and research departments have been renamed to better reflect the breadth and depth of their research that is undertaken.

In addition, this Annual Report provides a thread of 12 summaries of the impact case studies, some of which we will submit for the REF2021 exercise. In all, these summaries, feature articles and research departmental updates provide an overview of how LSTM has continued to translate its scientific approach into discoveries; diagnostics; treatments; practices and policies that have a beneficial effect on patients and populations.

As a research powerhouse LSTM remains outward facing, forward thinking and partnership driven to break the cycle of poor health and poverty.

Professor Steve Ward

Deputy Director



Biometric scanning to increase our understanding of how patients with TB symptoms progress through the health care system in Malawi

Neglected Tropical Diseases

LSTM is working to identify critical bottlenecks in the field of Neglected Tropical Diseases (NTDs) through its research and implementation activities, whilst evaluating alternative strategies to overcome the existing barriers and to improve strategies for their control and elimination.

In response, LSTM focuses on a multidisciplinary approach to NTDs, building on the particular strengths of its academic departments. This draws together a broad range of existing NTD expertise and creates new areas for collaborative programmes across LSTM.

LSTM's Centre for Neglected Tropical Diseases (CNTD) continued its key role in the implementation of control and elimination NTD programmes with a new £15m three-year award from DFID's ASCEND (Accelerating the Control and Elimination of Neglected Tropical Disease) programme targeting five of the worst NTDs: lymphatic filariasis, onchocerciasis, schistosomiasis, visceral leishmaniasis and trachoma in 25 of the world's poorest countries.

Lymphatic Filariasis

CNTD's operational research has focussed on lymphatic filariasis (LF) morbidity management and disability prevention, which is

a central component of the WHO objectives for LF elimination. The CNTD team has developed, implemented and evaluated a range of reporting, field and survey tools to enable better estimates of patient numbers, assess the quality of health services, and quantify the impact of care on quality of life.

Specifically, 25,000 LF clinical case data collected using mobile phone text messaging (SMS) by health workers across seven countries were analysed and mapped to identify areas with very high numbers of cases 'morbidity hotspots' and help LF programmes optimise the distribution of limited resources and target surveillance strategies.



Laitchani Levson developed LF in 2001. His three-year-old granddaughter Efrieda is pictured next to his swollen leg - © Simon Townsley/Daily Telegraph

A new hospital facility assessment checklist was developed and used by LF programme managers in Bangladesh, Malawi and Nepal to help identify the hospitals with good quality services and those requiring improvements for hydrocoele surgery. An enhanced care protocol for lymphoedema was developed and implemented by patients with moderate to severe conditions in Bangladesh and Ethiopia with improvements in quality of life and reduction of disability.

Focusing on morbidity and disability: Thinking beyond elimination

In Liberia, the LSTM led **COUNTDOWN** consortium has been at the forefront of supporting research linked to the newly developed Integrated Case Management plan with the inclusion of a mental health component. It is using person centred approaches that prioritise the beliefs and values of patients to address stigma and discrimination. Preliminary findings show a need for the strengthening of referral pathways for the management of morbidity associated with NTDs and a need to insure treatment for all. This moves beyond those interventions and diseases currently prioritised and promotes a holistic intervention delivery to facilitate integration into the health system.

Improved strategies and guidance for Community Drug Distributors (CDDs)

COUNTDOWN undertook a systematic review of policies focused on the African situation for CDDs in NTD programmes. WHO global and regional documents and select African national NTD programme master plans assume CDDs will implement NTD programmes but offer little with regard to management and motivation of this vital cadre. In Nigeria and Ghana, research identified that a certificate of recognition to be a strong source of motivation for CDDs. In Ghana, **COUNTDOWN** research of CDD motivation has resulted in CDD training doubling from 2 days to 4 days. This was in response to a request from CDDs themselves for more extensive instruction. Another finding emerging from social science research in Ghana is CDDs' desire to be identified as part of the health care system.

A Participatory Action Research (PAR) process in Nigeria led to an increase in the number of female CDDs trained with an 32% increase from 2017 to 2018. It is estimated to have improved therapeutic coverage by 10% due to increased access to households, improved structures of training processes and timing which aided increased knowledge and understanding, awareness and acceptability of the programme. Female CDDs were able to gain access to households where men could not. More women were sensitized and in turn mobilised other households in the community.

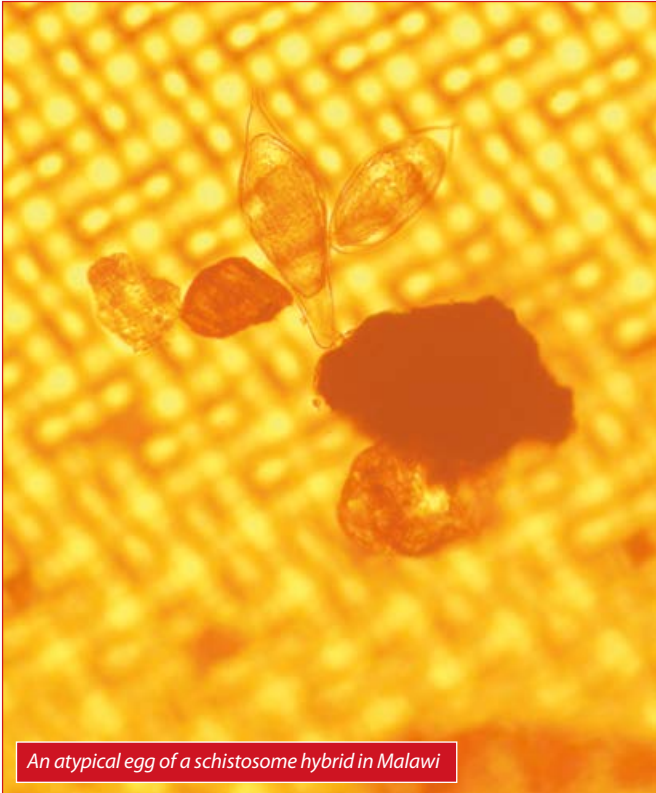
Mainstreaming gender, disability, equity and rights

COUNTDOWN is at the forefront of the global NTD gender and equity agenda. It highlighted key gender differences in exposure to NTDs as well as their associated manifestations and lived experience. Strengthening this approach is critical to ensuring NTD programming and its scale-up is equitable and informed by community voices. The team has been active in the WHO Gender and Equity working group, made up of donors, partners and researchers, which aims to improve gender responsiveness in NTD programming and ensure no one is left behind.

COUNTDOWN worked together with in-country partners to complete the first pilot of WHO's Gender, Equity and Rights (GER) toolkit for Preventive Chemotherapy NTD Programmes in Nigeria. As an outcome of the initial pilot, and collaborative feedback provided by **COUNTDOWN**, WHO has made modifications to the toolkit, which has now been agreed to be piloted in a second state, Kwara. The first phase of implementation was to review existing programmatic data to explore ongoing gender equity and rights issues as well as to conduct qualitative and gender analysis training with the state NTD team. From this analysis geographic areas, where inequities in programmatic coverage have been experienced, were identified as priority areas for an in-depth qualitative analysis to take place.



A Community Drug Distributor with a measuring stick



An atypical egg of a schistosome hybrid in Malawi

A new focus on genital schistosomiasis in women and men

Urogenital schistosomiasis is caused by infection with *Schistosoma haematobium*, an important parasitic disease in sub-Saharan Africa and is well-known to cause significant damage to the urinary tract. This aspect of disease gives rise to either female genital schistosomiasis (FGS) or male genital schistosomiasis (MGS), where eggs of the parasite damage the internal or external genitalia. To draw international attention on this aspect of disease, several LSTM staff recently assisted COR-NTD to hold a discussion workshop in Liverpool, to assess its importance with HIV infection, cervical cancers and women’s wellbeing in general.

As part of expanded workplans of **COUNTDOWN**, it has recently drawn attention to female genital schistosomiasis in Ghana and for health systems to adapt and respond appropriately. Using a qualitative method approach, community members and associated health workers were interviewed to find widespread misconceptions about FGS. The signs and symptoms of this disease were confused with other sexually transmitted infections such that adolescent girls who reported with vaginal discharge and itching were often stigmatised by health workers for promiscuity, which left their FGS incorrectly managed. Looking to the future, integration of praziquantel treatment within sexual and reproductive health services in primary health care services may raise the profile of this unrecognised condition and provide guidelines for its treatment.

With regard to MGS, a systematic review of cases reported across the globe has been conducted by PhD student Dr Seke Kayuni, a research clinician from Malawi. Many adult fishermen

who are on antiretroviral therapy exhibit classic MGS where eggs of *S. haematobium* can be found in semen, as well as cause overt damage to tissues. Since all current diagnostics in use for MGS are imperfect, it is important to take an integrated diagnostic approach to better manage MGS patients.

Centre for Snakebite Research & Interventions (CSRI)

LSTM’s expanding snakebite research portfolio reflects the global situation. Thus, in the past two years the tropical snakebite disease domain has been radically transformed from a globally neglected medical condition dismissed as an ‘injury or accident’ to a WHO priority Neglected Tropical Disease. In May this year, WHO also launched its strategy to halve global snakebite mortality and morbidity rates by 2030. LSTM’s Professors Harrison and Laloo were lead writers of this new strategy to reduce the 138,000 deaths and 400,000 disabilities caused by snakebite every year.



Led by Professor Rob Harrison, and with £9.6m funding by the Department for International Development for the *Scientific Research Partnership for Neglected Tropical Snakebite* (SRPNTS) project, CSRI has added the development of monoclonal antibody-based next generation snakebite therapies to LSTM’s therapy-discovery portfolio.

It also recruited new research partners in San Diego, USA (International Aids Vaccine Initiative), and in Bangalore, India (Indian Institute of Science), to its existing National Institute of Health Research-funded African Snakebite Research Group. It undertakes clinical, biological and socioeconomic research with newly established Snakebite Research & Intervention Centres (SRICs) in Kenya and Nigeria to measure the burden of disease and devise systems, protocols and recommend evidence-based policies to significantly improve snakebite management in these countries and across Africa.

Supplemented with £100k funding from Wellcome to establish a SRIC in Eswatini (formerly Swaziland), CSRI leads the largest, most multi-disciplinary and geographically diverse research consortium ever deployed for snakebite. This is timely because it places LSTM and its many partners in a competitive position to benefit from Wellcome Trust’s 2019 announcement of a new £80m/7-year snakebite research programme.

Other examples of LSTM’s health policy influence include Professor Harrison’s consultation by the Presidential Committee for North East Nigeria Initiative on snakebite and antivenom issues, his meetings with Ministers of Health in Kenya and Nigeria, his organisation of the 2019 All Parliamentary Party Group for malaria and NTDs upon the topic “*Delivering effective*

healthcare and systems to reduce the global burden of disease caused by tropical snakebite: what still needs to be done?”. CSRI’s Deputy Head, Professor Nick Casewell, has led LSTM’s advocacy campaign to raise awareness of the health burden of tropical snakebite and actions to address this.



A Nigerian saw-scaled viper, responsible for over 80% of snakebite deaths in Western Africa, crawls over vials of Fav-Afriqne antivenom – a product that has been discontinued by the manufacturer and replaced by less effective products. ©Simon Townsley/Daily Telegraph

Elimination of Lymphatic Filariasis

LSTM’s Centre for Neglected Tropical Diseases (CNTD)’s research is focused on WHO’s Global Programme to Eliminate Lymphatic Filariasis (GPELF) two main goals, which include mass drug administration (MDA) to interrupt transmission, and morbidity management and disability prevention (MMDP) to alleviate suffering. Research is conducted across 12+ project countries in collaboration with Ministries of Health and research institute partners. Focusing on the impact of large-scale multi-country MMDP activities, CNTD has been involved in nearly 40,000 hydrocoele surgeries, identification of over 85,000 lymphoedema patients being registered for care and more than 50,000 health care workers being trained in lymphoedema management and treatment. 36,000 health care workers were trained in lymphoedema and hydrocoele case finding, some of whom were trained to use mHealth tools for reporting cases to a central level.



Department of Tropical Disease Biology

The start of this year began with a new name for the Department. Driven by our expansion into new priority research areas beyond 'traditional' parasitology, we are now the Department of Tropical Disease Biology.



Professor Mark Taylor
- Head of Tropical Disease Biology

Diagnostics

The Department's Diagnostics group in the Centre for Drugs & Diagnostics (CDD), headed by Dr Emily Adams, is a good example of our expansion into new research areas. Her group is recruiting patients to the Breathspect project, which is testing a simple to use diagnostic to distinguish non-bacterial pneumonia and sore throat from bacterial infections, in order to better triage patients for antibiotic therapy. The group continues to develop diagnostics for the containment level 4 viruses Lassa fever and Crimean Congo Haemorrhagic fever (CCHF) working with BioGene and Genedrive on close to patient testing. Another industrial collaboration with Biofortuna focusses on an anti-microbial resistance (AMR) assay, which can detect 10 markers of AMR in a single, cheap and easy to use test, planned for commercialisation in 2020, and undergoing evaluation in Nepal. Promising results using antibody detection methodologies to differentiate eleven types of flaviviruses are being developed for more specific tests for diagnosis of returning travellers and to understand the epidemiology of these important but difficult to distinguish viruses. Finally, malaria parasites are deleting genes which underpin rapid diagnostic tests for malaria leading to false-negative results. The group have been able to detect HRP2 negative malaria parasites in Indonesia for the first time. This push to 'diagnostic resistance' is incredibly important to monitor and the group's current focus is to develop and evaluate alternative malaria diagnostics that do not rely on detecting HRP2.

Antimicrobial Resistance (AMR)

Our increasing activity in AMR, headed by Dr Adam Roberts, has been recognised with an NIHR award of £3.54m in partnership with the University of Liverpool and LSTM's Centre of Excellence in Infectious Disease Research (CEIDR). The project aims to develop a patient centred approach to prevent and treat AMR, by tailoring the right drug and dose for the patient, instead of the current same drug and same dose for every patient.

Schistosomiasis

Significant changes in the epidemiology of schistosomiasis have been reported by Professor Russell Stothard in *Emerging Infectious Diseases* that concern intestinal and urogenital schistosomiasis in Lake Malawi. It is now confirmed

that the freshwater snail vector *Biomphalaria pfeifferi* has permanently colonised the Mangochi District shoreline, introducing an outbreak of *Schistosoma mansoni*. In addition, two novel hybrid schistosomes, *S. haematobium-S. mattheei* and *S. haematobium-S. bovis*, have been detected in Malawian school children, often in co-infection with intestinal schistosomiasis. The latter hybrid is particularly worrisome, for it is now dispersing across Africa from its likely origin in Senegal and is responsible for the introduction of disease transmission on Corsica, the first report of urogenital schistosomiasis naturally occurring in Europe. These hybrid schistosomes highlight a zoonotic potential and the need for a OneHealth approach to control schistosomiasis in Central Africa.

Centre for Snakebite Research & Interventions (CSRI)

The newly established Centre, led by Professor Rob Harrison, continues to expand following the funding of the 'Scientific Research Partnership for Neglected Tropical Snakebite' (SRPNTS) consortium. This £9.6 million award, funded by DFID, will support CSRI and lead partners at the International Aids Vaccine Initiative (IAVI) and collaborators in India, Kenya and Nigeria to develop new therapeutics for tackling snakebite in the highly endemic regions of sub-Saharan Africa and India. Using technologies developed for the design of HIV vaccines, the SRPNTS product development partnership seeks to utilise monoclonal antibodies as broadly effective, safe and affordable new snakebite therapies.

The NIHR-funded 'African Snakebite Research Group' programme continues to grow, delivering data accrued from new clinical and socioeconomic research surveys conducted by our partners in Nigeria and Kenya (Snakebite Research & Intervention Centres, SRICs). This year an additional SRIC was established in eSwatini (formerly Swaziland) thanks to Wellcome Trust funding of our clinical trial preparedness project. Professor Nicholas Casewell secured MRC funding for a new project exploring the potential of non-antibody-based therapeutics for treating snakebite in ways that are more affordable and safer than current antivenom therapy.



A-WOL, led by Professors Mark Taylor and Steve Ward with Dr Joe Turner, continues to progress new drug candidates for safe macrofilaricidal drugs for onchocerciasis and lymphatic filariasis. The discovery and development of A-WOL's first candidate selected anti-wolbachial drug, a repurposed macrolide ABBV-4083 (TylaMac), was published in Science Translational Medicine and has successfully completed Phase I testing in humans and is now progressing to Phase II testing in DRC in partnership with Abbvie and DNDi. The highly selective anti-wolbachial drug, AWZ1066, was published in the Proceedings of the National Academy of Science and is undergoing formal pre-clinical development through MRC DPFS funding in partnership with Eisai.

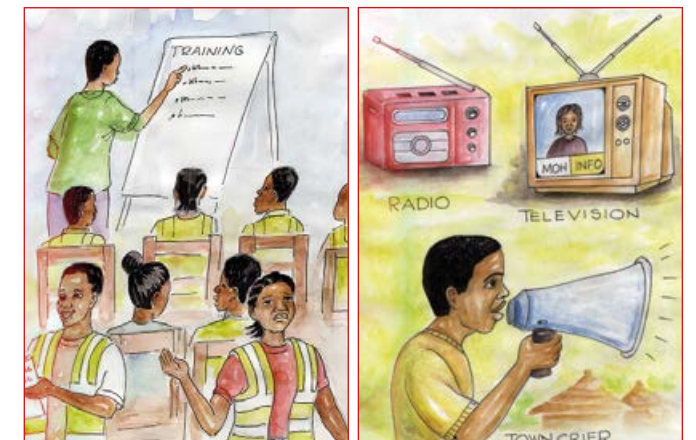
Other publications include our collaboration with AstraZeneca's High-Throughput Screening Group to screen 1.3m compounds from AZ's collection in just 10 weeks generating 20,000 hits and 9 chemical series with rapid and potent anti-wolbachial activity as published in Nature Communications. A-WOL is also working to identify the targets of our new drugs and to understand the mode-of-action of our new rapid-kill compounds with aim to further reduce the treatment regimens for onchocerciasis and lymphatic filariasis.

'Dancing' parasites in mice

Research from Dr Joe Turner's group was showcased in the National Centre for Reduction, Refinement and Replacement (NC3Rs) 2019 Research Review. Dr Turner is a recipient of a PhD Studentship and Project Grant from the NC3Rs to develop alternative research models that can be applied in the development of new drugs against filarial infections causing elephantiasis, river blindness and heartworm disease. The review featured the work of PhD student, Amy Marriott, who has validated a non-invasive ultrasound technique to detect the "dance" of filarial parasites and interpret drug treatment responses, potentially halving the number of rodents necessary to evaluate candidate-filarial drug cures. Another highlight from Dr Turner's group included the development of a rodent model of 'Tropical Eye Worm' caused by the *Loa loa* parasite, as published in Nature Communications. This parasite is particularly difficult to treat and is notorious for disrupting control and elimination programmes across Central Africa due to the risk of severe adverse events during mass drug administration campaigns.



COUNTDOWN has continued to perform very well this year and rated 'A+' in DFID's annual review. A two-year extension through to 2021 for Nigeria and Liberia, two of the four current COUNTDOWN countries has been awarded by DFID, taking the programme of implementation research to 7 years.



Drawings from Liberia used to validate research findings with local communities

The programme has worked proactively and collaboratively with NTD policymakers and programme implementers in partner countries to help maximise the impact of COUNTDOWN generated evidence. In Nigeria, COUNTDOWN is represented on the Federal MoH NTD Programme research sub-committee and has involved NTD actors at Federal, State and Local Government in the design and delivery of research. In Liberia, participatory research design and dissemination at national and county level led to the collaborative development of a national NTD communications strategy. Following publication of a study in Ghana on female genital schistosomiasis (FGS) that identified key gaps in knowledge



Community group discussion on FGS in Ghana

and understanding of FGS within local communities COUNTDOWN has facilitated the application of new evidence to programming, developing proposals to update the curriculum for health staff and launching an FGS sensitisation campaign including training of health workers.

COUNTDOWN continues to engage at the international level, by contributing to the development and multi-country partner roll out of WHO's Gender, Equity and Rights Toolkit and by contributing to the NGDO Onchocerciasis Elimination blueprint advocacy document.

Organisational and institutional capacity building efforts have been focussed around developing strong independent research teams able to conduct high quality research and inform policy development. **COUNTDOWN** partners have successfully leveraged additional funding from various sources including NIHR, UNDP and TDR special programme, based at WHO.



This year CNTD was awarded £15m as part of DFID's flagship ASCEND (Accelerating the Control and Elimination of Neglected Tropical Disease) programme in partnership with Sightsavers, The Schistosomiasis Control Initiative and Mott MacDonald. Announced by Parliamentary Under-Secretary of State, Baroness Sugg, during

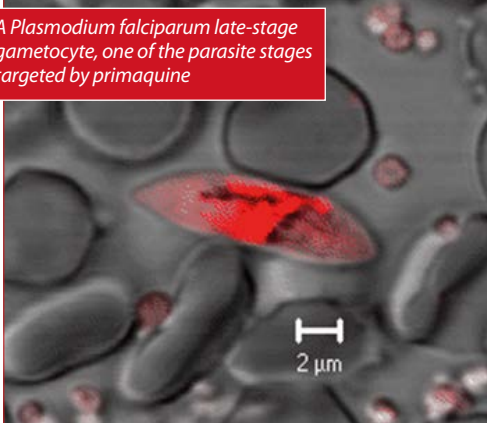
her visit to Liverpool and LSTM, the funding will support implementation of mass drug administration and morbidity management and disability prevention for five of the worst NTDs: lymphatic filariasis, onchocerciasis, schistosomiasis, visceral leishmaniasis and trachoma in 25 of the world's poorest countries. CNTD will cover 13 of these countries in West and Central Africa.

Malaria

Professor Giancarlo Biagini's group made significant steps in understanding the way that the antimalarial drug primaquine (PQ) works as reported in Nature Communications. PQ was developed 70 years ago with an estimated 200 million doses administered. Whilst PQ has been the only drug available for radical cure of relapsing malaria, as well as showing transmission blocking efficacy, its use is limited due to its potential side effect of red blood cell toxicity in patients with G6PD deficiency, a common blood disorder in people living in malaria endemic countries. In collaboration with investigators from the University of Liverpool, the London School of Hygiene and Tropical Medicine and from the Massachusetts Institute of Technology, USA, Professor Biagini's team were able to replicate

the interaction between the drug and the host enzymes which catalyse the generation of cytotoxic amounts of hydrogen peroxide from metabolites of the drug. It is anticipated that this detailed understanding of the mechanism of PQ will pave the way to rationally re-designed second-generation PQ drugs.

Dr Ian Hastings' group continued the work on pharmacological modelling of malaria drug treatment and clinical trials. It confirmed that the WHO-recommended drug regimen for treating severe malaria is probably optimal but an article in Lancet Infectious Diseases highlighted that the WHO-recommended methods of analysing malaria drug clinical trials is likely to be highly inaccurate and should be urgently



A *Plasmodium falciparum* late-stage gametocyte, one of the parasite stages targeted by primaquine

updated, with suggestions on how best to improve the methodology.

One of the host receptors that allows *Plasmodium falciparum* infected red blood cells to stick to small blood vessels in the human host is called Intercellular Adhesion Molecule 1 (or ICAM-1). Malaria parasites vary in the types of ligands, known as PfEMP1s, that they express on the infected red blood cells with some being strongly associated with severe disease (type A) and others with more mild disease (type B). The molecular interaction with type A PfEMP1 had been described, but the type B complex remained elusive until recently. Published in the Proceedings of the National Academy of Science with Professor Matt Higgins' group at Oxford University, Professor Alister Craig has shown that the shape of the complex formed between type B PfEMP1 and ICAM-1 is different than that seen with type A PfEMP1, which may influence the way in which the infected red blood cell influences changes in the host blood vessels that are associated with disease.

Community health workers

LSTM's research in Africa and Asia has shown that community health workers (CHWs) can be effective and cost-effective in expanding health care access. Researchers found that their performance is mediated by intervention design and contextual factors reflecting the vital interface role that CHWs play between communities and health systems. LSTM developed a quality improvement model that transforms the way community health integrates into the health system and demonstrated that this integration can sustain beyond project funding. The work is referenced by WHO, used by national governments and shifted the global debate on quality for CHWs.

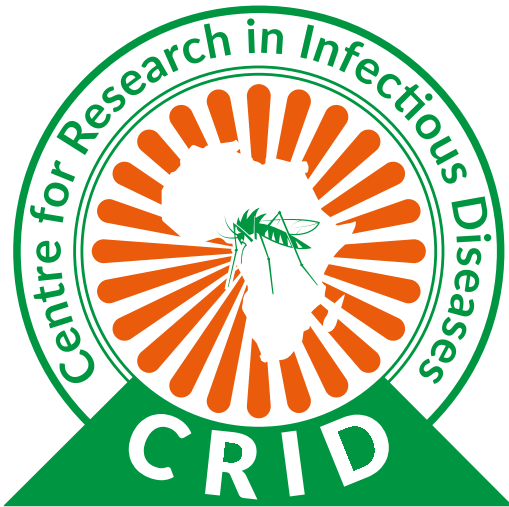


Malaria and other Vector Borne Diseases

LSTM hosts one of the largest groups of Vector Biologists in the world and has seen rapid expansion in recent years. The group has an unparalleled diverse research portfolio in vector borne diseases (VBDs), from mosquito genomics to health economics, and spans the basic science to translational research pathway. The profile of VBDs has arguably never been so high.

While the global burden of malaria has dramatically declined over the past two decades, there is evidence that these gains are stalling, and new tools are urgently needed. Likewise, emerging vector borne diseases, such as Zika and Dengue, threaten the status quo, particularly in sub-Saharan Africa. The technical expertise, strong collaborations with research partners in disease-endemic countries and commitment to producing the next generation of VBD scientists, puts LSTM in a prime position to tackle these issues.

Cameroon's Centre for Research in Infectious Diseases (CRID)



The Centre for Research in Infectious Diseases (CRID) is a research Centre located in Yaoundé, Cameroon, and is hosting a research unit from LSTM under the leadership of Wellcome Trust Senior Fellow, Professor Charles Wondji. CRID's mission is to contribute to the fight against infectious diseases in Africa by providing an excellent environment to perform high quality and internationally recognised research in Cameroon and the

Central African region. CRID builds on its strong collaboration with LSTM to perform research on infectious diseases such as malaria, sleeping sickness, yellow fever and emerging vector-borne diseases such as Zika, Dengue and tick-borne diseases. LSTM staff collaborating with CRID include Professor Hilary Ranson on capacity building of African scientists as part of the Partnership to Increase the Impact of Vector Control (PIIVEC), Professor Phil McCall on arbovirus vectors, Dr Lisa Reimer on xenomonitoring and Professor Steve Torr and Dr Inaki on tsetse fly control. CRID currently has one of the highest concentrations of Wellcome Trust fellows in Central Africa with three fellows: Dr Basile Kamga, Dr Emmanuel Elanga and Dr Cyrille Ndo as well as four Research Career Development staff supported by PIIVEC. This partnership offers a great opportunity for LSTM scientists to study infectious diseases in Central Africa, a region which still lags behind other African regions in term of research.

Rewriting the rulebook of mosquito dispersal

In arid areas of Africa *Anopheles* mosquitoes and malaria apparently disappear during the dry season but upon resumption of rains, mosquitoes return rapidly. With no surface water for breeding for vast distances, the source of immigrants is a long-standing mystery because mosquitoes are thought to disperse only short distances. Work in Malian villages has provided evidence to overturn this dogma. Led by Dr Tovi Lehmann of the National Institute of Allergy and Infectious Diseases (NIAID) in the USA, the research team used helium balloons suspended hundreds of metres above ground with sticky traps attached at different heights to collect insects travelling on high altitude air currents. With molecular entomology support from LSTM researchers to identify species, this innovative sampling methodology captured *Anopheles* mosquitoes, including a disproportionate number of bloodfed females capable of disease transmission, which meteorological modelling shows may have travelled up to 300km in huge numbers. Vector migration from well beyond country borders is a previously unrecognised challenge to malaria elimination targets.

Measuring the cost of “free” vector control

A new vector control intervention involving mosquito proofing of houses (with screening and closing entry points) and the fitting of eaves tubes has recently been evaluated in a cluster randomised trial in Ivory Coast. Eaves tubes provide a means to deploy insecticides at eave level, potentially providing community level protection from malaria. The intervention



Vast numbers of mosquitoes are present at high altitudes - Nature - © Taina Litwak (SEL-USDA)

was provided to households free of charge, however, the economic evaluation conducted alongside the trial by Health Economist Dr Eve Worrall showed that in addition to provider costs of around £196 cost per house, households incurred costs of around £20 by accepting the intervention. The costs incurred by households included food and accommodation for the installation teams, water for mixing cement and time spent emptying and cleaning the house before and after the installation of eaves tubes. These activities are primarily undertaken by women in the Ivorian communities where the trial was located, revealing an interesting gender perspective on the household costs of vector control interventions. The trial results and the economic evaluation results are being disseminated in Ivory Coast in October 2019 before being submitted for publication.

Breakthroughs in insecticide resistance using big data

Insecticide resistance in malaria vector mosquitoes is a threat to global public health. Three major insecticide resistance mechanisms are known: clearance of insecticides through

increased action of enzymes; changes to the target site of the insecticide reducing its efficacy and increased thickness of the mosquito cuticle, reducing penetrance of insecticides. Two recent studies in the vector group have uncovered some of the underlying genetic basis behind these mechanisms.

As part of an MRC Skills Development Fellowship, Dr Vicky Ingham is leading a study to identify novel resistance mechanisms through the integration of big data. So far, several new proteins involved in insecticide resistance have been identified through the integration of 31 datasets from across Africa comparing the gene expression levels in resistant and susceptible mosquitoes. This data is available through an application hosted by LSTM (IR-TE_x). Currently, Dr Ingham is investigating the loss of resistance in a previously insecticide resistant mosquito population through comparative whole genome- and RNA- sequencing of the original resistant colony and the newly susceptible colony and also investigating how exposure to insecticide causes changes to the underlying gene expression and how this is controlled. This is done through a collaboration with Lancaster University.

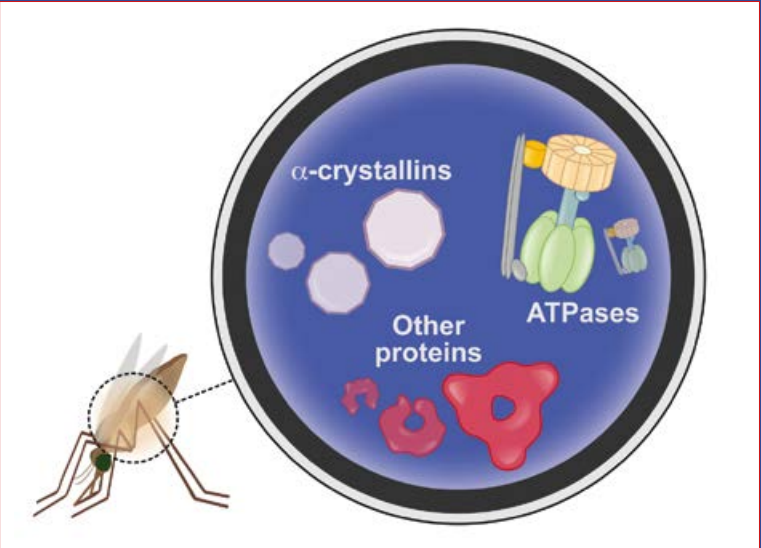
While the existence of cytochrome p450-based (metabolic) resistance is well-established, the understanding of the genetic mutations that cause it remains limited. One type of mutation that could lead to elevated metabolic resistance is the duplication of key metabolic genes, which increases the number of copies of these genes. In a paper recently published in Genome Research, researchers in the groups of Professor Martin Donnelly and Dr Dave Weetman used the resources of the *Anopheles gambiae* 1000 genomes project to perform genome-wide searches for copy-number variants (CNVs). This revealed that selective pressures caused by insecticide exposure have strongly influenced the evolution of gene duplications in this species, with over-representation of metabolic genes in duplicated genomic regions, multiple independent duplication events in key resistance genes, evidence of strong natural selection for these duplications, and over 90% of individuals showing evidence of gene duplication in some highly resistant populations. The challenge now is to quantify the effect of these CNVs on insecticide resistance so that we can effectively monitor resistance, inform vector control strategies and identify new targets for control efforts.

Ensuring that long-lasting insecticidal bed nets (LLINs) remain effective despite insecticide resistance is a global health priority and a research goal for many vector biologists at LSTM. An LSTM-led team has found a simple solution by demonstrating that insecticidal net barriers on the bednet roof greatly improve its efficacy. Fortuitously, insecticides up there are beyond the reach of children, never touched by the bednet’s occupants or rarely touched by anyone during routine activity, permitting the safe use of many more insecticides on bednets than currently possible. Tested against wild resistant *Anopheles gambiae* in Burkina Faso, ‘Barrier Bednets’ consistently performed well, even with an insecticidal barrier on an untreated bednet, reducing costs dramatically. Mathematical models predict that barrier

bednets can match efficacy of WHO’s recommended LLINs and, with minor modification, become even more effective. Requiring only existing insecticides and production technology, barrier bednets could soon reach at-risk communities.

Innovation in monitoring for Human African Trypanosomiasis

Surveillance for neglected tropical diseases is a challenge when faced with low infection rates. To overcome this, LSTM vector biologists are exploring the potential for a new low-resource tool for monitoring Human African Trypanosomiasis (HAT), which is earmarked for eradication by 2030. The concept is based on the technique of collecting and concentrating the excreta from mosquitoes, a method which has already been validated in the laboratory of Dr Lisa Reimer for the detection of malaria, filarial worms and trypanosomes. Using this method to detect the presence of HAT within a community will help to identify appropriate areas for targeted vector control and active case screening programmes. To trial this method as a monitoring tool, LSTM PhD Student Joseph Pryce and colleague Dr Tito Trésor Melachio (CRID, Cameroon) were recently awarded \$25,000 as the first winners of the NTD Innovation Prize from the American Leprosy Missions (see also Awards & Honours).



Cryptococcal meningitis

Cryptococcal meningitis is a serious opportunistic infection that occurs in the advanced stages of HIV. Until recently, it was responsible for 500,000 deaths per year. LSTM, with several UK partner institutions, has played a leading role in 5 pivotal trials that generated clear, policy-relevant knowledge on how mortality from cryptococcal meningitis can be prevented.

The most recent one was a large phase 3 trial conducted in multiple centres in West and East Africa. It showed that shorter and simpler antifungal regimens for the treatment of cryptococcal meningitis were as effective as the gold standard treatment, which because of its cost and complexity was available in very few African health facilities. These findings led to new rapid WHO guidelines and subsequently to changes in national policy and clinical practice across sub Saharan Africa.



Department of Vector Biology

The Department of Vector Biology has a research portfolio that spans studies on the functional genomics, behaviour and ecology of disease vectors, to clinical trials, implementation research and the development of tools for monitoring and evaluation of disease transmission. Our aim is to contribute to the control or elimination of vector borne diseases afflicting the world's poorest populations.



Professor Martin Donnelly
- Head of Vector Biology

New Head of Department

In April 2019, LSTM announced the appointment of Professor Martin Donnelly as the new Head of the Department of Vector Biology.

Professor Donnelly, who is a Royal Society Wolfson Fellow and an Honorary Faculty Member at the Wellcome Sanger Institute, took the position following Professor Hilary Ranson stepping down from the role to become REF coordinator for LSTM's 2021 submission.

Trained at Girton College, Cambridge University, Professor Donnelly studied for his MSc and PhD at LSTM. He was awarded an American Society of Microbiology Fellowship, spending two years at the Centers for Disease Control and Prevention (CDC) in Atlanta, USA. He returned to LSTM, joining the Department of Vector Biology in 2001 and being named as its Deputy Head in August 2017.

A major area of interest is the evolution of insecticide resistance in the malaria mosquito *Anopheles gambiae*. His team use a variety of genomic, transcriptomic and proteomic approaches to identify and validate insecticide resistance associated loci. He also collaborates with a network of sub-Saharan Africa partners to integrate these diagnostics into both malaria control programmes and randomised control trials designed to assess the epidemiological impacts of insecticide resistance.



WHO tube assay to test insecticide resistance of *Anopheles* mosquitoes

Wellcome Trust Senior Fellowship renewal

Cameroon-based Professor Charles Wondji has had his Wellcome Trust Senior Fellowship renewed for the next five years, which will continue to support his work within LSTM's Department of Vector Biology.



Professor Charles Wondji

The grant is formally titled: 'Molecular basis of the escalation of insecticide resistance in malaria vectors and its impact on malaria control'. It is worth over £2 million and will see research carried out both within LSTM and the Centre for Research in Infectious Diseases (CRID) in Cameroon.

Malaria prevention relies extensively on mosquito control using insecticides. However, insecticide resistance in major transmitting-mosquitoes threatens malaria control in Africa. As with the original award, Professor Wondji and his team will use the power of deep genome sequencing coupled to extensive functional analyses and field testing, to fill this gap in knowledge by thoroughly deciphering the genetic and molecular drivers of super-resistance to insecticides in the mosquito *Anopheles funestus* across Africa.

The possibility that super-resistance is caused by mosquitoes producing higher amounts of enzymes able to breakdown insecticides faster and/or more efficiently will be investigated and DNA markers associated with this trait identified. Evidence that mosquitoes are hardening their body armour, or cuticle,

to reduce insecticide uptake will be investigated and tools designed to track this resistance will be developed.

Through extensive field studies in Cameroon, this project will establish the extent to which this resistance may be reducing the efficacy of insecticide-treated nets and thereby contributing to the increase in malaria cases being reported in Africa

ESSENTIALS project

Earlier in 2019, LSTM was awarded a US\$3.9m grant from the Bill & Melinda Gates Foundation for the ESSENTIALS project. This initiative aims to speed up the evaluation process for new malaria control tools, to ensure they are deployed as early as possible in affected communities.

The project is led by Professors Ranson and McCall at LSTM, in collaboration with Imperial College and national medical research institutes in Burkina Faso (Centre National de Recherche et de Formation sur le Paludisme, CNRFP) and Tanzania (National Institute for Medical Research, NIMR). The aim is to develop a robust set of entomological indicators that can be used to assess the public health value of new vector

control tools, reducing the need for lengthy and expensive randomized controlled trials.

The ESSENTIALS (Essential Entomological Indicators for Assessment of LLINs) project will be conducted in the same sites as key clinical trials, or large-scale pilot deployments of Next Generation bednets, now getting underway across Africa, enabling results from LSTM's modelling predictions to be compared with epidemiological data from those trials or programmes.

The Inaugural Hemingway Fellowship

The Department of Vector Biology (DVB) continues its expansion with the launch of the inaugural Janet Hemingway Fellowship named after the former LSTM Director. Funded by charitable donations the Hemingway Fellowship honours the lasting contribution that Professor Janet Hemingway has made to the field of vector-borne disease control. The fellowship is designed to support gifted, early-career vector biologists to transition to internationally-recognized research leaders. The award will be made every three years.



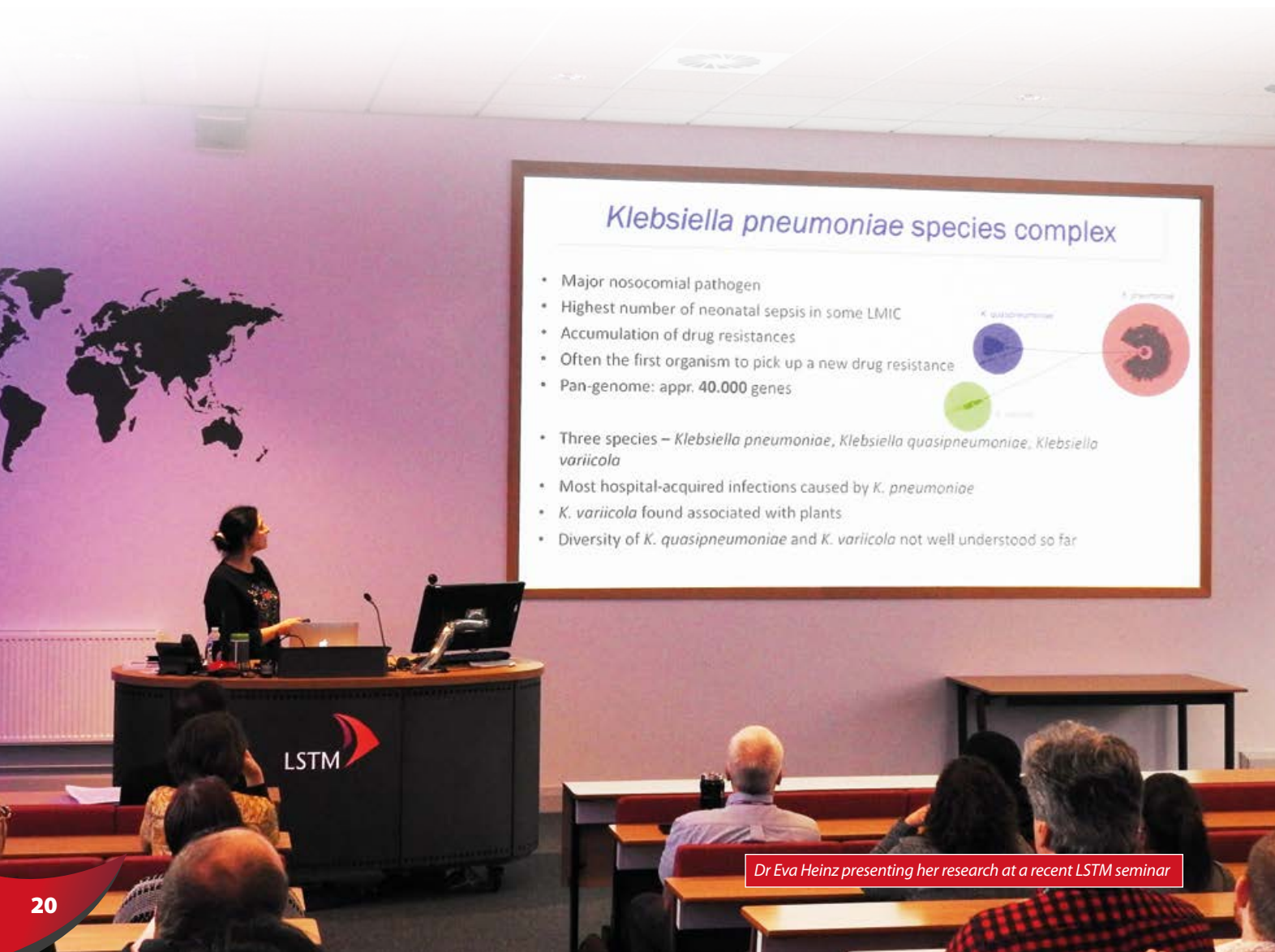
A study bed net hanging up in a living space in Burkina Faso

Resistance Research and Management

LSTM's Antimicrobial resistance (AMR) research activity and international collaborations have continued to grow extensively this year with researchers winning multiple grants for innovative research and surveillance both at a local level here in Liverpool and internationally. Academics have authored significant publications on AMR and population genomics of globally important human pathogens.

Klebsiella pneumoniae

Dr. Eva Heinz, recently recruited to LSTM from the Wellcome Sanger Institute, has been awarded a two-year prestigious Wellcome Trust Seed Award. Her team is studying *Klebsiella pneumoniae* a human pathogen which is increasingly becoming resistant to even our most potent antibiotics. Dr Heinz, who is an internationally recognised expert in population genomics will lead a global comparison of bacterial collections, collected over long time frames in the UK, Argentina and Malawi.



Dr Eva Heinz presenting her research at a recent LSTM seminar

These three, highly distinct geographical settings will enable Dr Heinz and collaborators, Dr Corso from the Argentina Reference Centre of Antimicrobial Resistance, Instituto Nacional de Enfermedades Infecciosas (INEI), Buenos Aires, Argentina, Professor Feasey from LSTM and the Malawi-Liverpool Wellcome centre (MLW), Blantyre, Malawi and Professor Thomson from the Wellcome Sanger Institute and the London School of Hygiene and Tropical Medicine (LSHTM), to address one of the fundamental questions: why are some lineages of *K. pneumoniae* so much more successful as hospital pathogens than their close relatives and can we find the Achilles' heel of these successful resistant lineages?

This success results from Dr Heinz's extensive experience on bacterial population genomics through a large variety of national and international collaborations. Recent outputs include descriptions of the only large-scale genomic studies to date from the Caribbean through a collaboration with Dr. Brindle from the Caribbean Public Health Agency (CARPHA), who also led the first training courses in the Caribbean for pharmacists to increase awareness of antimicrobial prescribing practices.

Further work with several teams at Addenbrooks hospital in Cambridge, Public Health England (AMRHA PHE), and the Wellcome Sanger Institute showed a strong temporal signal in *K. pneumoniae* population, which underwent 1.5 - 2 year cycles of a dominant lineage, before being replaced with another one. Understanding bacterial populations and resistance at a genomic scale provides insights into how, and why, they are successful at spreading amongst healthcare facilities and within our environment.

Salmonella

Other pathogens are also under investigation at LSTM. A new extreme-drug resistant lineage of *Salmonella* is currently circulating in central Africa, and our WGS-based study furthermore showed the emergence and radiation of a new lineage with strong signs of host-adaptation in the Democratic Republic of Congo (DRC), a study with Dr Heinz based on a large multi-centre collaboration between Institut National de Recherche Biomédicale (INRB) in Kinshasa, DRC, the Institute for Tropical Medicine (ITM) in Antwerp, Belgium, and the Wellcome Sanger Institute. Similar patterns of host adaptation are known for *Salmonella* Typhi, the main cause of typhoid fever, have alarmingly also been detected by a research team including LSTM/MLW's Professor Feasey.

FIEBRE study

Genomics has also been a significant contributor in the epidemiology of *S. Typhi*, and continued surveillance is essential given the recent finding of a new resistant lineage in Zimbabwe in the course of the Febrile Illness Evaluation in a Broad Range of Endemicities (FIEBRE) study, where Professor Feasey is the Principal Investigator for Malawi. This is a large collaborative effort between LSHTM, LSTM, the Barcelona Institute for Global

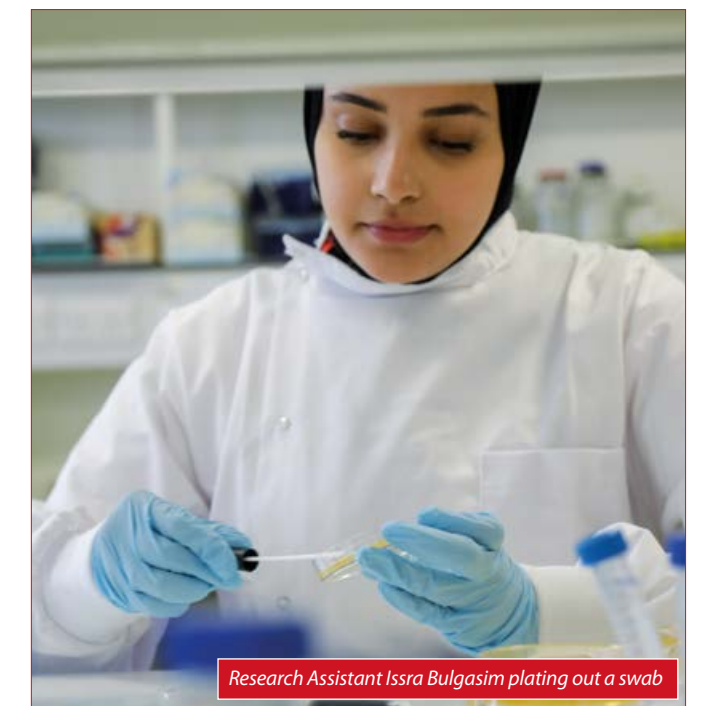


Febrile Illness Evaluation in a Broad Range of Endemicities

Health (ISGlobal), the University of Oxford and the University of Otago, and partner institutions and national reference laboratories in Lao PDR, Malawi, Mozambique and Zimbabwe. Continued efforts on *S. Typhi* vaccine implementation and a better understanding of *S. Typhi* carriage and interaction with the host are essential if we are going to combat increasing AMR in these bacterial species.

AMR surveillance and research

Closer to home, Professor Feasey and Dr Roberts are part of a consortium, led by University of Liverpool (UoL), who won a £3.5million NIHR AMR capital grant to provide infrastructure across the Liverpool campus in order to carry out AMR surveillance and research. This award not only strengthens the already significant collaborations between LSTM and UoL, but also means that our expertise, which we have developed working overseas for decades, can be applied at a local and national level here in the UK. Further work with the Liverpool hospitals has seen new collaborations emerge. Drs Alasdair Hubbard and Thomas Edwards are currently characterising an outbreak of antibiotic resistant *Escherichia coli* that recently occurred in one of the Liverpool hospitals to gain a better understanding of what led to the development of this antibiotic resistance.



Research Assistant Issra Bulgasm plating out a swab

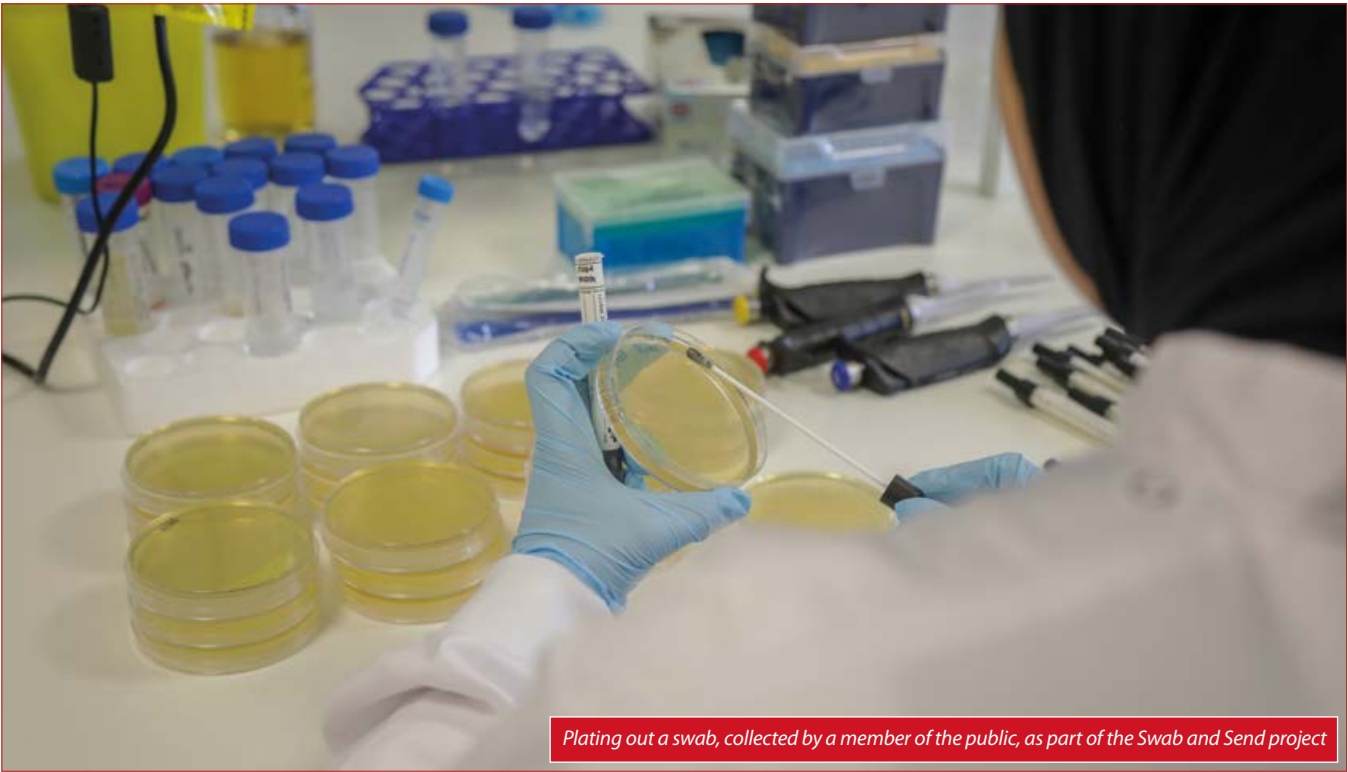
Senior Research Associate, Dr Russell Dacombe, is leading LSTM efforts within two different consortia, led by Development Alternatives International, that have won Fleming Fund Country Grants for both Pakistan and Nigeria. In Pakistan the grant will run for 18 months with £3 million awarded and in Nigeria the grant will run for 36 months with £10 million awarded. The Fleming Fund Country Grants programme assists countries to collect high quality data relevant to antimicrobial resistance (AMR) and helps low and middle income countries to start building a sustainable national surveillance programme to fight AMR.



Isolates of bacteria collected from public swabs tested against *Micrococcus luteus*. Some zones of inhibition can be seen

Swab and Send

Dr Adam Robert's crowd-funded citizen science project Swab and Send has encouraged members of the public to swab their home environment in the hunt for the next antibiotic, an important project considering there has not been a novel antibiotic discovered in the past few decades. Swab and Send, as well as being a source of isolates for Dr Roberts and his team to study, also acts as a unique platform for members of the public to learn about this important topic and engage them in the fight against antibiotic resistance. Since the start of the project in 2017 over 1500 swabs have been sent in.



Plating out a swab, collected by a member of the public, as part of the Swab and Send project

A team of post-doctoral researchers, led by LSTM's Dr Adam Roberts, have completed The Transposon Registry records for all transposons assigned Tn numbers where records exist.

The Transposon Registry provides a robust platform system in order to allow researchers to describe and search for transposon elements in prokaryotes in publications and databases.



TRANSPOSON
REGISTRY

A transposon is a segment of DNA that is capable of moving from one location in a genome to another, either in the same cell or sometimes between different cells. They are responsible for the transfer of antimicrobial resistance genes, amongst other things, and represent a significant challenge in terms of controlling AMR.

The nomenclature of transposable elements was first discussed in a meeting on DNA Insertions in the USA in 1976. A set of rules for the nomenclature were modified, which was subsequently revised in 1979, due to development of early DNA sequencing techniques. Over time however the records were either not published or a variety of nomenclature systems were developed by different research groups. To fill this gap the "Tn Registry" was launched in 2006, hosted by University College London, London, UK and an accompanying description published in 2008.

In 2017 the Tn registry moved to LSTM and was upgraded, updated and renamed. The registry is now fully searchable and can be updated by users as and when their sequences are deposited and when their publications arise by linking their individual records to accession numbers and digital object identifiers respective.

The registry can be accessed via: <https://transposon.lstmed.ac.uk/>

Department of Clinical Sciences

The department continues its cutting-edge translational science from concept through discovery to health impact. This includes research into Viral Haemorrhagic Fevers; Paediatrics, Menstrual Health as well as Controlled Human Infection to improve vaccines for respiratory pathogens, in understanding how to manage severe infection. Major programmes in Low and Middle Income Countries (LMIC) serve to improve the quality of care for chronic respiratory disease and tuberculosis, critical illness and sepsis, expand our NHS-research focus, and provide capacity building and research training.



Professor Daniela Ferreira - Head of Clinical Sciences

Viral Haemorrhagic Fever

LSTM plays an important role in response to public health emergencies globally. Last year Dr Shevin Jacob was deployed by the WHO to the Democratic Republic of Congo in response to the ongoing outbreak of Ebola. Dr Jacob became lead author on a perspective, published in the New England Journal of Medicine, calling for universal standards of care to be applied in relation the care of people with the disease.



Dr Shevin Jacob, second right, and WHO colleagues in Eastern DRC

Dr Tom Fletcher's research in Crimean-Congo Haemorrhagic Fever (CCHF) continues and he remains part of WHO R&D Taskforce for CCHF. The group's current focus is evaluating novel diagnostic platforms for CCHF and Lassa fever in partnership with the German based Bernhard Nocht Institute of Tropical Medicine and building towards CCHF clinical trials. Dr Fletcher also co-chaired a two-day conference in partnership with the University of Liverpool and Public Health England: *High Consequence Infectious Disease from bench to outbreak response*. It brought together speakers from the NHS, MSF and numerous international institutions and hospitals.



LSTM's High Consequence Infectious Disease conference - June 2019

At a strategic level LSTM has also agreed to form a collaboration with LSHTM for VHF research, bringing together the best expertise and networks from both institutions.

Paediatrics and Child Health

Professor Stephen Allen continues his work on improving nutrition in vulnerable newborns. He has entered into a partnership with a philanthropic organisation, the Children's Investment Fund Foundation (CIFF), on a new £2 million project in Kenya. With undernutrition being responsible for an estimated 45% of child deaths globally they aim to assess whether probiotics and prebiotics, given as supplements to young infants, may improve gut health through supporting the development of a healthy gut microbiome. Working in partnership with the Kenya Medical Research Institute (KEMRI) in a 52-month project, they aim to recruit 600 newborn babies in Homa Bay county, western Kenya. Newborns will either be given one of two different synbiotics, a prebiotic alone or usual feeds without any supplement. The team will record growth and episodes of illness in all children as well as testing stool and heel/finger prick blood samples to look for biomarkers of gut health, inflammation and growth. All children will be followed-up to age 2 years.

In a complementary study, the contribution of poor gut health to stunting in young children in Senegal, India and Indonesia will be assessed as part of the multidisciplinary GCRF Action Against Stunting Hub. In clinical research at Alder Hey Children's Hospital, Liverpool, the potential for faecal volatile organic compounds in the diagnosis of inflammatory bowel disease and the acceptability and effects of bovine colostrum in paediatric Crohn's disease are being assessed in NIHR-funded projects.

Menstrual Health

Professor Penelope Phillips-Howard and her team are collaborating with the Kenya Medical Research Institute (KEMRI), in conducting a randomised controlled trial among



Professor Penelope Phillips-Howard

~4000 schoolgirls to evaluate if the provision of cash transfer or menstrual cups, or both, will reduce girls' risk of school dropout or of acquiring HIV or HSV2. To support this research, and other studies and programmes internationally, the team led by Professor Phillips-Howard, conducted the first scientific review about menstrual cups, which found them to be safe, potentially as effective as other products, as well as reducing cost and saving waste.

Professor Phillips-Howard is also developing research with UK partners to undertake a pilot-study working with impoverished communities here in the UK, with the hope that the learning from the work in Kenya can be translated into a UK setting.

Malaria epidemiology

The malaria epidemiology team, led by Professor Feiko ter Kuile, continues its collaboration with the Kenya Medical Research Institute and the US Centers for Disease Control and Prevention in western Kenya, where they conduct research on malaria in pregnancy, innovative studies to track transmission intensity involving pregnant women in addition to transmission reduction studies. Four PhD students are enrolled as part of these studies.

Tropical Clinical Trials Unit (tCTU)

The tCTU continues to support high quality clinical trials in low and middle-income countries with studies on HIV, malaria, tuberculosis, respiratory infections, non-communicable diseases, reproductive health and infection prevention. The unit has had a successful year which included securing 6 new projects, due to start in 2019 or 2020, including the BabyGel trial, a large, cluster-randomised control trial which will be coordinated from the tCTU, along with partners from Bergen University and University of Liverpool. The DoPHIN2 trial has completed recruitment, exceeding the planned recruitment target 9 months sooner than planned and the PMC study presented its primary endpoint results to the consortium in March 2019 in Malawi. The Unit had one new staff member which will contribute to its intention to expand its skillset and expertise, building on the current infrastructure to make the services more robust and efficient.

IMPALA

Now in its third year, The International Multidisciplinary Programme to Address Lung Health and TB in Africa (IMPALA) led by Professors Squire, Mortimer and Dr Angela Obasi has five PhD projects and 3 post-doctoral projects work across the translational spectrum. The large IMPALA cohort study in Uganda continues to recruit and characterise the health and economic wellbeing of pregnant women, examining important putative risk factors for early-life lung damage - air pollution in the home, poverty and nutrition are carefully tracked into infancy. Multidisciplinary working is being enhanced using Dr Yan Ding's survey leading to opportunities for networking, cross-fertilisation, and broadening collaboration networks.

Tuberculosis

The first ever Post-TB Symposium in Stellenbosch, supported by IMPALA, brought 27 institutions and more than 13 different disciplines together to generate advocacy for a previously neglected issue. Dr Tom Wingfield is working on studies in Nepal, Vietnam, Mozambique, and Peru running trials that



Dr Peter MacPherson testing computer-aided chest x-ray diagnosis for TB

evaluate the impact of integrated socioeconomic interventions for TB-affected households on health and financial outcomes. Dr Peter MacPherson is testing the effectiveness of computer-aided chest x-ray diagnosis for tuberculosis. Using linked neighbourhood health surveys in Malawi, Peter's epidemiology research seeks to better understand the heterogeneity in undiagnosed infectious diseases, allowing more effective and efficient targeting of control and preventive interventions.

Pan African Thoracic Society methods in epidemiologic, clinical and operations research (PATS-MECOR)

IMPALA, ARCS, the Aldama foundation and PATS have continued to support research training for health professionals in Africa. This year, 36 PATS MECOR students from 11 African countries received interactive training, senior mentorship and assistance in research methodology, initiation of research projects and publication. Special training in spirometry, air quality monitoring, biostatistics and publishing were provided.

Critical Illness, Sepsis and Antimicrobial resistance

Sepsis has become a prominent global issue; even without the complications of antimicrobial resistance, recognition and treatment are difficult, both at individual and health systems level. Sepsis and critical illness have become a major programme of work within the £2m NIHR African Research Collaboration on Sepsis (ARCS), co-led by Dr Jamie Rylance and Dr Shevin Jacob. This will estimate the burden of sepsis across 10 countries, pilot multifaceted interventions to improve care quality including the use of ultrasound and real-time data platforms in early and accurate detection of septic focus. The £3 million MRC-funded *Drivers of Resistance in Uganda and Malawi* (DRUM) consortium, led by Dr Nick Feasey, is a dissection of how human infections are driven by the wider environment.

NHS

The Department continues to work on NHS-based research and aims to increase its visibility further in this area. This includes large scale trials: Dr Graham Devereux is recruiting to 84 sites, with 80 more expected, in a trial of beta-blockers in Chronic Obstructive Pulmonary Disease. In the area of infectious diseases, Professor Daniela Ferreira and Dr Andrea Collins, continues pioneering pneumonia vaccine research using the globally unique pneumococcal human challenge model. This year the team completed a Clinical Trial to test the potential of using Genetically Modified pneumococcus as nasal live vaccines. Building on BreathSpec Horizon 2020 work of Professor Nick Feasey, the CEIDR funded PneumEx study is testing the utility of detecting volatile organic compounds as a diagnostic device.

Lung Health and TB

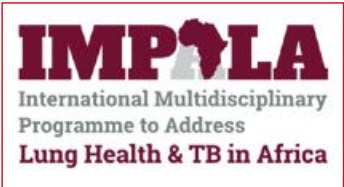
LSTM’s lung health and tuberculosis (TB) research takes a holistic, person-centred perspective, recognising that men and women, boys and girls experience a heavy burden of lung disease which manifests with a range of symptoms including as disabling coughing, breathlessness, and wheezing.

The causes of these problems are complex, very often rooted in poverty, and include infections such as *Mycobacterium tuberculosis* and *Streptococcus pneumonia*, and non-communicable conditions such as asthma and chronic obstructive pulmonary disease.

The solutions require multi-disciplinary collaborations aimed at both prevention and management of the full spectrum of communicable and non-communicable lung conditions.

IMPALA project in Uganda

The National Institute for Health Research (NIHR)-funded Global Health Research Unit IMPALA (International Multi-disciplinary research Programme to Address Lung Health & TB in Africa) hosts a number of research Projects in Africa.



In Uganda, IMPALA Post-Doctoral Research Associates Rebecca Nantanda (chest physician) and health economist Zelalem Terfa co-lead a birth cohort study which will deliver unique evidence of the impact of food insecurity, mother’s dietary diversity and in-house air pollution on infant lung health. These factors are thought to have a direct bearing on pregnant mothers’ well-being thus influencing the growth and development of the lungs of the baby during pregnancy and consequently impacting on the lung function at birth and throughout the life course. It is anticipated that findings from this inquiry will inform a package of preventative strategies to prevent poor lung health among the people of Uganda and similar settings.

The past year has seen a series of activities that have led to significant progress in project implementation. After obtaining ethical approvals from Uganda and LSTM, a team of 11 research assistants and 1 field coordinator were recruited, trained and deployed to start data collection. The project has such a rich

and wide scope of factors being investigated that it required 4 categories of research assistants with specific skills sets; 1) the midwives for the clinical aspects of the participants, 2) the Air Quality Monitoring Team, 3) the survey team focusing on household socioeconomic status and 4) the lung function team that is involved in conducting spirometry for mothers and lung function testing for babies.

Community political leaders, community health workers and influential elders in the study sites were oriented about the study aims, objectives and processes/activities. This process has been instrumental in gaining acceptance in the community, encouraging participation in the study and getting feedback about the project.



Lead investigator, Dr Rebecca Nantanda, sensitizing community leaders about IMPALA Project in Uganda

Besides engagement of communities in the study sites, the investigators have engaged with other key stakeholders in lung health including academics and policy makers. Currently, review of government policy documents from key sectors such as health, environment and agriculture is ongoing to understand the policy provisions for lung health in Uganda. Stakeholder analysis is ongoing to inform the relevant stakeholders to engage at national level. The rationale is to advance the agenda for lung health in Uganda as a way of addressing lung health and TB in Uganda in a multidisciplinary way.

Data collection started in April 2019. Recruitment is over 55% of the required number and well on target. The lung function testing and air quality monitoring teams are gaining lots of experience from the project implementation. Although a lot of research has been taking place in this community, this was the first study to focus on lung health and thus generated a lot of interest and curiosity. Community members have expressed the need for more studies to include other categories such as men and older children, because they believe that it would be helpful to address the high burden of lung diseases.

After presenting progress at the IMPALA Annual Partners Meeting in Tanzania this June, an idea emerged to collect food price data to estimate the cost of dietary diversity within the communities being studied. As a result, another branch of data collection is being integrated into the ongoing cohort study. The plan is to collect food price data from local markets in the study area for one year, once a month, to capture seasonal variations. The focus is on access to dietary diversity by women of reproductive age. The study will estimate the cheapest food categories to achieve dietary diversity requirement in Uganda to add to the already emerging picture of how socioeconomic status of mothers affects the lung function of their babies.



Breathspec

LSTM coordinated the recruitment of over 1,250 participants over 6 months at 4 Liverpool NHS sites, and 3 further afield in Wales, Scotland and Leicester. In this observational study, the device collected breath from patients suspected to have bacterial respiratory

tract infection. The study aims to identify biomarkers (volatile organic compounds) in exhaled breath to differentiate between a bacterial and non-bacterial infection by collating a large dataset.

The goal is that this device becomes a *Point of Care* diagnostic in primary care to differentiate bacterial and non-bacterial upper and lower respiratory tract infections to aid clinician decision making, ultimately reducing antibiotic prescribing and anti-microbial resistance. The study is funded by Horizon 2020 and is now been analysed by the Breathspect consortium, with results expected in early 2020.

PROSPECT study

Tuberculosis (TB) is the leading adult infectious killer in the world. In Blantyre, high rates of HIV infection and social deprivation, i.e. crowded, poor quality housing; air pollution, poverty combine to fuel TB disease rates. TB diagnosis in primary care can be challenging. Patients are often unwell for prolonged periods and may attend the health centre multiple times. The existing tests for TB are either not accurate enough, too slow and require centralised laboratory infrastructure, or too expensive for widespread implementation (GeneXpert MTB/Rif).



Digital chest X-ray

LSTM's Dr Peter MacPherson is based at the MLW Clinical Research Programme in Blantyre, Malawi, and leads a programme of research designing and evaluating interventions to speed up TB diagnosis using novel diagnostics to reduce the number of missed cases. This includes the PROSPECT study, funded by the Wellcome Trust. Adults attending the Bangwe primary care clinic with cough have been rapidly screened for TB using high-throughput digital chest X-ray. Careful monitoring of over 5000 adults entering and leaving the clinic showed that TB symptoms are very common (~30% have cough), but very few are offered TB tests or correctly diagnosed.

The PROSPECT study has investigated if a new artificial intelligence, computer-aided TB detection programme can speed-up diagnosis. Because there are very few health workers skilled in diagnosing TB using chest X-rays in Malawi, an automated approach is needed. The CAD4TB system analyses chest x-rays for signs suspicious of TB in less than a minute, allowing health workers to focus further investigations towards the patients who most need them, and hopefully increase diagnosis rates, reducing costs, and improving patient outcomes.

Recruitment to the PROSPECT study is about to come to an end and the team is hoping to have gathered results for early in 2020.

IMPACT TB

IMPACT TB, led by LSTM's Dr Maxine Caws, is implementing and evaluating alternative case finding strategies for TB in communities in Nepal and Vietnam. The consortium, which includes Karolinska Institute (Sweden), KNCV (Netherlands), University of Melbourne (Australia) and Johns Hopkins University (USA), FIT Vietnam and Birat Nepal Medical Trust aims to provide evidence to support policy decisions by National Tuberculosis Programmes on practical strategies to achieve the END TB strategy in low and middle-income countries.



Community mobiliser Ms Sita GC loading sputum samples onto the drone for transport to the GeneXpert laboratory to be tested for Tuberculosis

Active case finding has been under way for two years in six districts of Ho Chi Minh City Vietnam and four districts of Nepal, with over 2,000 extra TB cases diagnosed and treated. Health economic evaluation has shown that active case finding has a significant role to play in reducing catastrophic costs for families affected by TB. LSTM, BNMT and Nepal Flying Labs collaborate to use drones to link remote Nepali health posts to central laboratory hubs and increase access to the most advanced TB diagnostic test- the GeneXpert.

Vaccine redevelopment for respiratory infection

The Respiratory Infection and Vaccine group, led by Professor Daniela Ferreira and Dr Andrea Collins, continues pioneering pneumonia vaccine research using the globally unique pneumococcal human challenge model. Over 1500 volunteers have been exposed to pneumococcal bacteria nasally to mimic natural exposure. With this experience, the project is being established in Malawi, amongst populations which are under-represented in vaccine research despite being the most globally important group for prevention. The teams in Liverpool and Malawi collaborate closely with a common goal: to test vaccines in high-risk populations, determine mucosal immune responses and accelerate vaccine discovery.



Expansion of the Accelerator Research Clinic (ARC)

In 2017, the group opened their own research clinic following a charitable donation from Unilever®. The clinic is managed by Dr Andrea Collins, Senior Clinical Lecturer and Respiratory Consultant and Sister Angela Hyder-Wright. With 5 clinical spaces for volunteers, within the Liverpool Life Sciences Accelerator (LLSA) building, this facility allowed clinic and lab to be adjacent allowing increased efficiency and sample quality.

Further growth of the group, due to a £3M Pfizer collaborative grant and a £0.75M Unilever grant, is now planned on the 1st

floor of LLSA to allow for 10 clinical spaces and more research staff. The clinic will now be able to offer support to facilitate clinical studies throughout LSTM.

Current work in the ARC is LSTM's first Clinical Trial of a Genetically Modified Organism (GMO) to look at future vaccine development. Building on £2m BreathSpec Horizon 2020 work, the CEIDR funded PneumEx study will test the utility of detecting volatile organic compounds as a diagnostic device. The group is planning the first UK Clinical Trial of Investigational Medicinal Products (CTIMP) - Preventing Pneumonia 2, due to open in 2020.

Multidrug Resistant Tuberculosis (MDR-TB)

In 2011 the WHO recommended management of MDR-TB was based on a protracted drug regimen which carried with it catastrophic out of pocket expenses, resulting in low adherence. LSTM has contributed to changes in WHO's guidelines documented in seven guidance documents since 2011 culminating in the issue of consolidated guidance in 2019. This latest guidance captures the paradigm shift towards using molecular diagnosis, reducing drug regimen timescales and the use of all oral regimens wherever possible along with out-patient management, including community-based delivery of the injectable antibiotic if needed.



Department of International Public Health

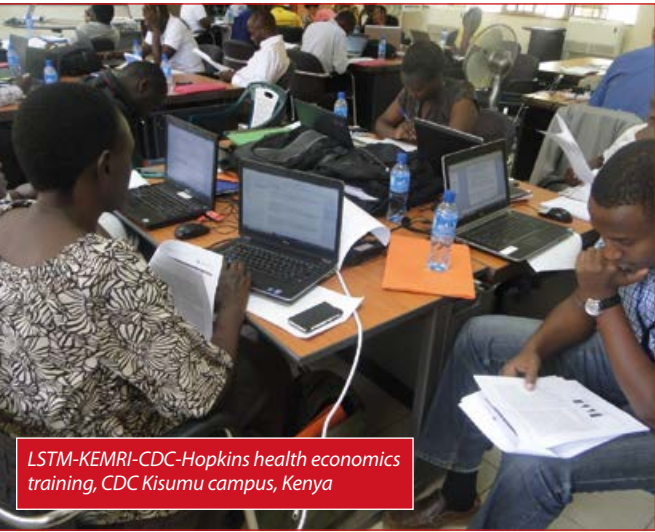
The department brings together people from diverse professional backgrounds to support a range of research models from individual fellowships and project grants to large multi-partner consortia. They particularly focus on health systems implementation research and pragmatic randomised trials to generate evidence to guide policy and practice on strengthening health systems and improving health care outcomes. The research is conducted in partnership with researchers and with policy makers in low-resource settings.



Professor Shabbar Jaffar
- Head of International Public Health

LSTM's global health economics group

This group, headed by Professor Louis Niessen, has newly joined the department and comprises health economists, epidemiologists and mathematical modellers. They conduct academic research and training and address economic questions in relation to disease control and health systems, mainly in low-resource settings.



LSTM-KEMRI-CDC-Hopkins health economics training, CDC Kisumu campus, Kenya

They do this by quantifying the health and economic burden of diseases including their poverty impact and assess the costs and cost-effectiveness of new health technologies and delivery approaches. This is complemented with research on healthcare financing and financial protection, and on efficiency and equity of health systems. Its current portfolio includes HIV prevention and control studies, diabetes and hypertension modelling, snakebite and neglected

tropical diseases, lung health and tuberculosis, prebiotics and symbiotic in infants, malaria control, and anti-microbial resistance and sepsis. The group also provides postgraduate Research training in Health Economics and mentors network of health economists across sub Saharan Africa through its research programmes.

Sexual and Reproductive Health Research in Botswana

Dr Chelsea Morroni, reader in International Sexual and Reproductive Health (SRH) and based in Botswana, is leading clinical and implementation research and policy work on improving contraceptive and sexually transmitted infection care and HIV – SRH service integration. She has recently led the development of new international programmatic guidance in this area for the WHO. She is also the Deputy Director of the UK Faculty of Sexual and Reproductive Health's Clinical Effectiveness Unit.



Members of the Botswana team presenting at the 7th Botswana International HIV Conference in Gaborone in 2018

Centre for Sexual Health and HIV AIDS Research (CeSSHAR) in Zimbabwe



HIV continues to have a massive burden in Africa. Twenty-million people are living with HIV-infection on the continent and over a million people are newly infected each year. Professor Frances Cowan is the Director of CeSSHAR in Zimbabwe. She leads the portfolio of implementation research including large-scale impact evaluations related to sexual and reproductive health and HIV infection.

In 2019, Professor Cowan was awarded a Wellcome Trust Collaborative Award in Science, which is supporting a multidisciplinary team to investigate the impact and cost effectiveness of approaches to strengthen differentiated care for sex workers in southern Africa. With Dr Sibanda, an awardee of the MRC African Leaders Scheme, she is conducting an evaluation of the Zimbabwe government's national elimination of mother to child transmission programme. Alongside Professor Miriam Taegtmeier, they are partners in the large consortium evaluating the expansion of HIV self-testing in Africa. See for more info the Feature Article on HIV elsewhere in this report.

NIHR Group on the prevention and management of HIV-infection, diabetes and hypertension

The burden of non-communicable diseases (NCDs) has risen sharply in Africa alongside the continuing high burden of infectious diseases. The department's research focus has therefore expanded to NCDs. It aims to generate evidence on health care delivery approaches, and biomedical prevention strategies.

A randomised trial to evaluate the use of metformin and cluster-randomised trials to evaluate integrated chronic care provision at the health facility and at the community level are about to get underway in Tanzania and Uganda, with co-funding from the EU.

The research is being conducted in partnership between European Centres (LSTM, Liverpool John Moores University, University of East Anglia, University of Bergen, University College Dublin, and ISGlobal Barcelona) and African research partners (National Institutes of Medical Research Tanzania, MRC/UVRI/LSHTM Uganda Research Unit, The AIDS Support Organisation Uganda and Hindu Mandal Hospital Tanzania with strong support from and in partnership with the Ministries of Health in Tanzania and Uganda).

Centre for Capacity Research

LSTM's Centre for Capacity Research (CCR) specialises in improving the health, wellbeing and economic development in low- and middle-income countries (LMICs) through the advancement of research capacity strengthening science. Led by Professor Imelda Bates and Dr Justin Pulford, the Centre works with funders, external agencies and with in-country institutions to identify any barriers which may be preventing them from functioning effectively.

Recently, CCR and the African Population and Health Research Centre (APHRC), have collated evidence to inform initial guidance about how to improve evaluations of, and indicators for, research capacity strengthening (RCS) programmes in LMICs. The project was funded by the internal DFID Strategic Evaluation Fund and addressed the linked problems of the lack of frameworks and robust indicators to determine the impact of RCS programmes. This research created a unifying, evidence-based approach to underpin funders' substantial investments in RCS efforts. The RCS evaluation recommendations and guidance resulting from this project should enable comparisons of RCS progress among projects and schemes and will facilitate real-time learning and tracking along a trajectory to achieve RCS impact.

In addition, CCR is working to develop a global standard for Good Research Management Practice (GRMP), in the African Academy of Sciences' Research Management Programme of work which addresses key systemic research management issues. The GRMP will standardise and strengthen the institutional management of research across and beyond Africa.



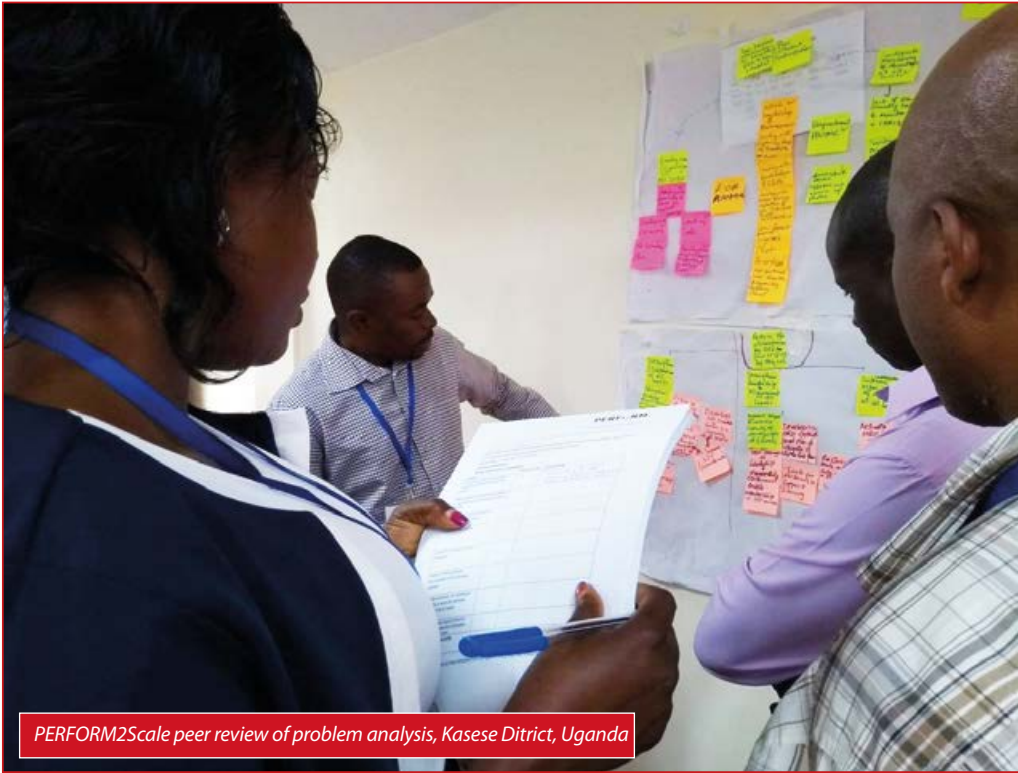
A diabetes clinic in Uganda participating in the NIHR Group's research study

Centre for Health Systems Strengthening (CHESS)

The department also hosts the Centre for Health systems Strengthening (CHESS – see also Feature Article on Health Policy and Health Systems Research).

Health Systems and Workforce Strengthening Unit

The ReBUILD project (health systems in fragile and conflict affected settings) ended after 8 years with a high scoring project report (A+) and over 85 publications. It influenced the work on health systems strengthening, amongst others, of UHC 2030 and WHO departments dealing with fragile states. Work on scaling up PERFORM2Scale, a management strengthening initiative, based on an action research approach, now covers 18 districts across Ghana, Malawi and Uganda. Governments in these countries are beginning to take over the process so the scale-up will be sustainable. The unit also contributes to research-based management development for improved child survival in a Horizon 2020 project called SUSTAIN, working in Rwanda and Ethiopia.



PERFORM2Scale peer review of problem analysis, Kasere Ditric, Uganda

Community Health Systems group

The group's work focuses on how best to support community health workers (CHWs) in the global push for Universal Health Care. In Uganda, DolPHIN2 has examined the health system impact of the roll out of Dolutegravir for women living with HIV; IMPALA in Kenya, Tanzania and Sudan are developing interventions that help identify chronic lung disease in communities. The group works with CESHAR in Zimbabwe to deliver an exciting community-led learning event, bringing together 10 districts from around the country that have led their own community distribution of HIV self-test kits in areas

previously hard to reach. In Kenya, the group has a close relationship with LVCT Health, a key partner for over the last 20 years. The 4byFour project has been funded by MRC to develop and pilot Quality Improvement approaches for community health workers in Migori, Kenya.

LSTM's Director's Catalyst Fund project aims to increase the uptake of HIV testing within black African communities within the local community in Liverpool by working with community leads to explore the key barriers to HIV testing to inform and develop a tailored HIV self-testing distribution model which meets the needs of the communities. This project partners with Liverpool City Council and Public Health Liverpool as part of the global HIV Fast-Track Cities Initiative to meet the UNAIDS 90-90-90 targets and stigma reduction.

Gender and social determinants

Departmental staff continue to play a role in COUNTDOWN, with participatory action research to strengthen NTD programmes, with a gender, poverty and disability lens. This research and partnerships was strongly featured at the European Tropical Medicine and International Health (ECTMIH) conference in Liverpool in September 2019. The group undertook a consultancy for UNDP on gender and NTDs. Ethnographic research into gendered every day realities of antibiotic use in urban and peri-urban Malawi has begun under DRUM. Highly productive discussions held between researchers and MoH policy makers from Sudan and Tanzania in improving health systems for chronic lung disease in Impala. Dr Kim Ozano was successful in obtaining a Directors Catalyst Fund award to develop participatory action research for health systems strengthening in Guatemala City.

HIV

As HIV continues to cause substantial mortality and morbidity, with over a million people newly infected in Africa each year, LSTM has seen an expansion in the extent and scope of HIV-related research. The HIV research portfolio now spans studies on HIV-prevention to comprehensive, integrated care for people living with HIV to management of late-stage HIV-infection. This research is leading to measurable positive impacts which are at the cutting edge of improved HIV care in Africa: preventing infections, saving lives and increasing the health and well-being of those affected.

Following on from the appointment of Dr Shabbar Jaffar a few years ago as Professor of Epidemiology, LSTM recruited Frances Cowan, Director of The Centre for Sexual Health and HIV/AIDS Research (CeSHHAR) Zimbabwe as a Professor of Global Health and Chelsea Morroni, as Reader in International Sexual and Reproductive Health. This year, Euphemia Sibanda, an epidemiologist with CeSHHAR and Webster Mavhu, Deputy Director of CeSHHAR, have joined LSTM as Senior Lecturers in Global Health and Dr Miriam Taegtmeier was promoted to Professor. All have a research focus on HIV-infection.

HIV prevention and testing

LSTM staff based full-time in Zimbabwe are leading research focussed on the prevention, treatment and care of HIV-infection through CeSHHAR Zimbabwe. This team leads the portfolio of implementation research including large-scale impact evaluations related to sexual and reproductive health and HIV infection.

Dr Mavhu and Professor Cowan have recently completed two cluster randomised trials evaluating the impact and cost effectiveness of novel approaches to demand creation for voluntary male circumcision for HIV prevention and of differentiated care for adolescents living with HIV (ALHIV).

The Zvandiri ('As I am') Trial for ALHIV is the first of its kind in Africa and has shown reductions in death and treatment failure after sustained follow up; findings that will have a profound impact on care for adolescents living with HIV through changes in policy and practice.

In 2019 Professor Cowan was awarded a Wellcome Trust Collaborative Award in Science which is supporting a multidisciplinary team to investigate the impact and cost effectiveness of approaches to strengthen differentiated care for sex workers in southern Africa. With Dr Sibanda, an awardee of the MRC African Leaders Scheme, she is conducting an evaluation of the Zimbabwe government's national elimination of mother to child transmission programme. Alongside Professor Miriam Taegtmeier, Professor Cowan and Dr Sibanda are partners in the large Self Testing Africa (STAR) consortium evaluating the expansion of HIV self-testing in Africa.



Man using HIV self-testing kit in Zimbabwe ©UNITAID

Professor Miriam Taegtmeier is Deputy Research Director and qualitative research lead of the UNITAID Self Testing Africa (STAR) project which has played a key role in the expansion of HIV self-testing in Africa – a potential game changer in the HIV field.

The convenience and privacy afforded by HIV self-testing has allowed large numbers of adolescents and previously untested men to access testing in Southern Africa. Its distribution at community level in Zimbabwe is not only welcomed by communities, but has led to empowered communities able to organise, distribute and report on self-test kits with the effect of increased ownership and normalisation of testing and reports of reduced stigma alongside greater uptake of treatment services in the communities. Professor Taegtmeier also leads work on designing and evaluating interventions to enhance HIV testing through other innovative methods, and on intimate partner violence and the HIV cascade.

HIV Fast Track Cities Initiative

LSTM is also working to bring lessons from the global South to HIV testing in Liverpool through our role in coordinating the HIV Fast Track Cities Initiative that brings together local government, civil society and health services. This Directors Catalyst Fund project aims to increase the uptake of HIV testing within communities living in Liverpool through a tailored HIV self-testing distribution model.



Health Goals Malawi

‘Health Goals Malawi’ is a two-year project in partnership with the Liverpool FC Foundation, using football as a convenor to engage with hard to reach adolescent and young males aged 14-24 with health services, particularly HIV self-testing. The project aims to reduce the transmission of HIV and other sexually transmitted diseases in Malawi, by raising awareness of support services and educating young people about the risks through capacity strengthening of community coaches.

In Malawi, the number of people living with HIV is one of the highest in the world and young people account for 50% of new infections. Incidences are highest among 14-24 year olds. Often these groups have low levels of awareness and access to contraceptive health services, therefore more likely to contract, or be living with, the disease unknowingly. Knowing their HIV status is the first step to living longer. In the first year of its delivery, the project engaged more than 600 young males.

Comprehensive care for people living with HIV

Dr Morroni, who is based in Botswana, leads clinical and implementation research and policy work on improving contraceptive and sexually transmitted infection care for people living with, as well as research on HIV – sexual and reproductive health service integration.

In 2019, she led the development of new international programmatic guidance in this area for WHO. A newly funded study led by LSTM with partners in Botswana and the University of Liverpool will investigate drug-drug interactions between hormonal contraceptives and HIV treatment regimens, as well as exploring contraceptive and reproductive-decision making in the context of HIV.

With partners in Africa and Europe and funding from NIHR and Horizon 2020, Professor Jaffar has started a long-term research programme evaluating models of integration of services for HIV-infection, diabetes and hypertension and on testing biomedical approaches to prevention of non- communicable diseases.

Management of advanced HIV disease

LSTM Professors Lalloo and Jaffar, in partnership colleagues at St Georges University of London, published findings from a large phase 3 trial of novel therapies for the management of cryptococcal meningitis, a serious opportunistic infection that occurs in the advanced stages of HIV. The research led to an immediate change in WHO guidelines, which in turn is leading to changes in policy and practice. Both professors are partners in a new phase 3 trial of Ambisome therapy for cryptococcal meningitis, being led by LSHTM and St Georges University of London.

Reviewing case records in an integrated HIV and non-communicable disease clinic in Uganda



HIV testing scale up

Over the last twenty years LSTM research has led to the development of a successful approach to the rapid scale-up of HIV testing and counselling (HTC) services in high prevalence countries, a vital component of the global HIV response. It combines comprehensive quality assurance with clinical trial and operational research and has led to HTC expansion in community and facility-based settings. LSTM is part of the STAR consortium that has catalysed the scale-up of HIV self-testing and treatment in Africa, empowering approaches that successfully reach younger adults, men and key populations. The impact of LSTM's work is reflected in WHO policy, Ministry of Health guidelines in sub-Saharan Africa, the work of non-governmental organisations and in community HTC in the UK.



Partnerships

Malawi Liverpool Wellcome (MLW) Clinical Research Programme

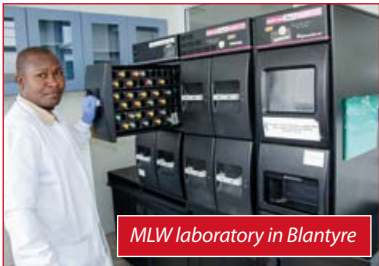
MLW has two aims that are both focused on low-income countries – research to benefit health and training the next generation of researchers. This year has seen tremendous progress in both domains. The number of Research Groups has remained constant at 14, but the size and ambition of the Groups has increased. MLW now has 750 staff, with over 250 publications and a grant income in excess of £ 15 million per year.

Successful year in science

MLW has implementation, intervention and observational studies in the community. HIV self-testing is being implemented in government facilities and research now focuses on hard-to-reach communities including young men (in partnership with the LFC Foundation) and fishing communities. Summary reviews of the large chapter of research leading to this implementation has been published as a special edition in the Journal of the International AIDS Society.

Intervention studies include vaccination, therapeutics and diagnostics. MLW has active studies in typhoid, rotavirus, pneumococcal, influenza and malaria vaccination. The typhoid study (TyVac) is the largest vaccine study conducted in MLW to date (over 28,000 children vaccinated in 6 months and now in active follow-up). Novel rotavirus vaccines are being used to combat the relatively low efficacy seen with these vaccines in highly endemic regions compared to affluent communities. To put this in context however, there has been a 39% reduction in child deaths from diarrhoea in Malawi. Novel pneumococcal vaccination regimens are planned in order to try and optimise herd immunity – it is expected that by altering the interval between vaccine doses carriage and hence community exposure will be reduced. The malaria team are leading observation studies of all disease in malaria vaccine (RTS,S) roll-out that will allow MLW to lead in predicting the next interventions to benefit community health.

Therapeutic trials based in the community include and azithromycin for bacterial diarrhoea as well as an RCT testing trial-of-treatment in TB. Trials in diagnostics have already demonstrated the role of gene Xpert and urinary LAM in diagnosing TB – the latest innovation in this Group is to determine the efficacy of computer aided diagnosis applied to screening chest X rays. Portable X-ray equipment developed for



military use may transform the diagnosis of TB in Malawi.

Important observational studies of chronic lung disease in both urban and rural adults and children have been completed and the complex task of unpicking the causes of a large burden of lung disease has begun. Drone technology has been applied for the first time in Malawi to track both dry and wet season mosquito populations, and to link this to insecticide resistance and the transmission of human disease.

Hospital and laboratory based studies

MLW is located at the Queen Elizabeth Central Hospital (QECH), adjacent to the College of Medicine (COM) – but also works in Zomba Central Hospital, several district hospitals, many health centres and in laboratories.

Studies in these facilities include targeted therapeutic trials such as amphotericin in cryptococcal meningitis, re-purposed agents for cryptosporidium diarrhoea and a trial of blood transfusion in infants. A diagnostic and management intervention in childhood asthma has already started and aims to improve asthma control in the urban population. The observational studies in patients will inform the next generation of intervention studies. Studies of adult sepsis, non-malarial coma and poor neonatal outcome aim to provide the critical data needed to plan interventions that will further reduce death from infection. Observational studies of stroke have shown the role of both HIV and hypertension in driving this new epidemic. A new stroke unit is under development.

A major cause for concern is the emergence of antimicrobial drug resistance (AMR) in bacteria in Malawi. Large studies in the hospital and the community are beginning to demonstrate the ubiquitous nature of extended spectrum beta lactamase (ESBL) resistance in stool isolates. Tracking and modelling studies are under way, supported by both clinical and environmental microbiology laboratories, to determine the pinch points at which the emerging AMR pandemic can be controlled. Drug resistant infections (DRI) have now become very evident in the deaths from Klebsiella infection among neonates and now recurrent drug resistant typhoid in adults.

As drug resistance increases, knowledge of host immunity becomes more important. Mucosal immunology is particularly relevant in defence against respiratory and gastrointestinal pathogens. Close collaboration between 6 of our Research Groups allows unique work at MLW to describe the host/ pathogen interaction at the mucosal surface in pneumococcal disease, tuberculosis, influenza, rotavirus and salmonella infections including typhoid. A recent exciting development is the launch of human challenge studies at MLW – starting with the pneumococcal carriage model developed in Liverpool. Cell sorting technology, tuberculosis reporter strains and single-cell transcriptomic techniques combined with the unique access

to both clinical populations and human challenge models will keep MLW at the leading edge of this field.

Successful year in training and development of staff

MLW training begins with internships managed by the Training Committee. This programme is developing considerable momentum with more than 20 interns working across the Groups. Interns are supported through MSc and PhD level Fellowship applications – MLW success is growing in these applications to Wellcome, Commonwealth and Beit Trust and has 30 PhD students among a total of over 100 trainees as well as several Wellcome Intermediate Fellows. Postdocs are nurtured as Associate Group Heads and develop their own careers, eventually becoming Group Heads. It is a measure of MLW success at 9 of the Group Heads previously held Fellowships at MLW.



This year 2 Group Heads were promoted to Chair, and 2 to Reader at LSTM. Substantial awards including Fellow of the Academy of Medical Sciences (Liz Corbett), NIHR Professor in Global Health (Melita Gordon), Royal Society Africa Prize (Henry Mwandumba) and African Research Leader (Kondwani Jambo) show that research at MLW develops careers all the way from early research experience to international acclaim.

Wellcome Trust Liverpool Glasgow Centre for Global Health Research (WTCGHR)

WTCGHR has been supporting the work of the MLW and acts as the focus of the Wellcome Trust Clinical PhD Programme, a scheme supporting the most promising medically qualified clinicians wanting to undertake rigorous research training.

The Centre will be undergoing changes as it moves from a Wellcome Trust supported centre to a joint LSTM University of Liverpool established facility.

KEMRI/CDC in Kenya

In Kisumu, Kenya, Professor Phillips-Howard and team continue their close collaboration with the Kenya Medical Research Institute (KEMRI) and are completing their randomised controlled trial among ~4000 schoolgirls which evaluates the effects of cash transfer or menstrual cups, or both, to reduce girls' risk of school dropout or of acquiring HIV or HSV2.



Other studies are ongoing, including a study with the University of Illinois at Chicago, investigating the effect of menstrual cups on the vaginal microbiome and potential implications for acquisition of STI and HIV among 440 post-pubescent girls, and an impact evaluation of DREAMS interventions on adolescent girls and young women at risk of HIV acquisition in western Kenya.

Next stage studies planned include following up the trial population to evaluate if intervention effects are sustained into adulthood, evaluation of the sexual and reproductive needs of out-of-school girls, and the burden of abnormal vaginal bleeding across the life-course. The team are also exploring opportunities to expand menstrual health research in the UK context.

The malaria related studies, led by Professor Feiko ter Kuile, include multicentre trials of malaria chemoprevention in the post-discharge management of children with severe anaemia, which are ongoing in eight hospitals in western Kenya and Uganda and two large chemoprevention trials for the control of malaria and sexually transmitted and reproductive tract infections in pregnancy in Kenya, Malawi and Tanzania.

KEMRI is also in the fourth of a five-year cooperative agreement with the US 'Centers for Disease Control and Prevention' (CDC) for joint malaria elimination and malaria vaccine studies in western Kenya. The team completed the first trial of high-dose ivermectin, a promising new tool for the control of malaria with exciting results that were published in the Lancet of Infectious Diseases in March 2018. LSTM Professors Donnelly and Torr have increased their collaboration with the entomology group in western Kenya, looking at novel methods for entomological surveillance of malaria vectors and insecticide resistance. On average 6 PhD students are enrolled in these studies.

Centre of Excellence of Infectious Diseases Research (CEIDR)

CEIDR (the Centre of Excellence in Infectious Diseases Research) is a joint centre between LSTM and the University of Liverpool, located in the Accelerator building. CEIDR is focused on commercial translation, seeking strategic partnerships with industry and academic organisations to advance drugs, vaccines and diagnostics towards market. Applying the technologies, expertise and resources of LSTM and the University of Liverpool and our clinical partners, CEIDR aims to minimise the impact of resistance on public health globally through diagnosis, prevention or treatment of infections by:

- Accelerating product development
- Providing access to clinical trials
- Sustainable use of new anti-infective products



In its first full year of operation CEIDR's Director Dr Fiona Marston has recruited a team of three; two Business Development Managers and an experienced Executive Assistant. The CEIDR team has completed its first strategic collaborations for its partners and in parallel is building its external presence and pipeline of prospective collaborations.

CEIDR has made excellent progress towards becoming a portal for external organisations to make connections, source expertise and resources in infectious diseases from LSTM, the University of Liverpool and its clinical partners.

The Liverpool-Guangdong Drug Discovery Consortium

The Liverpool-Guangdong Drug Discovery Consortium, in collaboration with University of Liverpool and academic institutes in Guangdong, China, focussed on the development of new drug therapies for the treatment of tuberculosis, malaria, neglected tropical diseases and other infectious diseases. The collaboration has been extended to include the South China University of Technology (SCUT) and Wuyi University. The group has developed a number of UK/China co-funded initiatives in the critical area of AMR.

MRC Confidence in Concept/Tropical Infectious Disease Consortium

LSTM's Centre for Drugs & Diagnostics (CDD) manages the Medical Research Council (MRC) Confidence in Concept, which brings together much of the UK's expertise in tropical infectious diseases into a single translational partnership, known as the Tropical Infectious Disease Consortium. The Consortium is between the Liverpool School of Tropical Medicine (LSTM), the London School of Hygiene and Tropical Medicine (LSHTM), the Jenner Institute at Oxford University and Public Health England, Microbiology Research Services, Porton Down (PHE), and is strategically placed to deliver an unprecedented portfolio of domain specific expertise in all the key research areas of interest. This year the Consortium realised ca. £40 million in follow-on funding from the CiC investments, the majority involving Consortium partners, as well as industry and external partners. Over the past five years, the Consortium attracted over 150 applications and funded themes included; 21 vaccines development projects (including an evaluation of a Zika virus fowl pox-based vaccine), 18 drug/biologics discovery projects, 16 diagnostic discovery/development projects (including AMR), 7 new insecticide resistance, surveillance and control tools, 3 anti-venom therapies, 2 adjunct therapy projects and 1 intervention (bed nets).

The Global Alliance to Eliminate Lymphatic Filariasis (GAELF)

LSTM has hosted the GAELF Secretariat since 2004. GAELF supports WHO's Global Programme to Eliminate Lymphatic Filariasis (GPELF) primarily by



advocacy and communication. This year, 14 countries are certified as eliminating LF as a public health problem with a further 7 in post-MDA surveillance.

Lancaster University

In 2016, the MRC-funded Translational and Quantitative Skills Doctoral Training Partnership (DTP) in Global Health was established between LSTM and Lancaster University.



The programme seeks to train the next generation of leading "bridge" scientists working in translational research in Global Health. Attracting further support from the RCUK National Productivity Investment Fund, the LSTM-Lancaster DTP currently has funding to support over 30 PhD studentships, most projects involving co-supervision of PhD students between the two institutions for collaborative projects in all of LSTM's departments and along the entire translational research pipeline continuum. The success of the programme was acknowledged by the MRC and in 2018 the programme was awarded further MRC funding for an additional ~16 PhD studentships.

The partnership has been further strengthened by the successful award of MRC Skills Development Fellowships (SDF) in Translational and Quantitative Skills in Global Health. This programme which will run for 6 years, again in collaboration with Lancaster University, is focused on training of PhD graduates in translational research with an emphasis in quantitative skills.

University of Liverpool



The academic collaboration to deliver education and research projects between LSTM and the University of Liverpool continues to thrive as illustrated in initiatives such as National Institute for Health Research (NIHR) Health Protection Research Unit (HPRU) in Emerging and Zoonotic Infections; MLW; CEIDR; LHP and LIV-TB.

HCRI & MSF

Together with the Humanitarian & Conflict Response Institute (HCRI) of the University of Manchester and MSF, the Leadership Education Academic Partnership (LEAP) integrates world-class higher education into the career paths of humanitarians, with the intention of strengthening



leadership within the sector. The inaugural cohort of LEAP students started in February 2019.

Liverpool Knowledge Quarter

KQ Liverpool is bringing forward new development opportunities, successfully attracting new investment, increasing the city's employment figures, improving graduate attraction and retention rates and establishing the Liverpool City Region as a key player in the Northern Powerhouse.



KQ Liverpool's strengths in life sciences, infectious diseases, sensor technology and materials chemistry attracted four new occupiers to its expansions site: Paddington Village. These include the Royal College of Physicians, Proton Partners International, who build Rutherford Cancer Centre and Rutherford Diagnostics Centre and Kaplan, who are opening Liverpool International College.

The KQ Liverpool partners are LSTM, the University of Liverpool, Liverpool John Moores University, the Royal Liverpool and Broadgreen University Hospitals NHS Trust, Liverpool City Council, Liverpool City Region Combined Authority, the Hope Street CIC and Liverpool Vision.

Liverpool Health Partners (LHP)

LSTM is a founding member of Liverpool Health Partners, a strategic partnership of 10 primary care NHS organisations, LSTM and the University of Liverpool. LHP aims to improve health and deliver exemplary research, education and healthcare across the Liverpool City Region.



NHS

The NHS regularly calls upon the expertise of LSTM clinicians who work across multiple trusts in the North West including the Royal Liverpool and Broadgreen University Hospital, Aintree University Hospital and Alder Hey Children's Hospital. Central to this is the Tropical and Infectious Diseases Unit (TIDU) at the Royal Liverpool University Hospital, which is staffed by a number of LSTM clinicians, all experts in different aspects of tropical medicine.



The Experimental Human Pneumococcal Carriage (EHPC) collaboration utilises the strong clinical links between LSTM and the Royal University Hospital with various studies examining the role of pneumococcal carriage in the nasal cavity in relation to susceptibility to disease and evaluation of interventions.

LIV-TB

LIV-TB is a collaboration between LSTM and the University of Liverpool with monthly seminars by its members and visiting researchers, which are open to all. These included talks about the pharmacology of TB medications, genetics of TB, how to prevent TB in HIV positive people in the UK and addressing TB in children. LIV-TB has been heavily involved with the UK Academics and Professionals to End TB group.



Public Health England

LSTM clinicians provide specialist advice to Public Health England (PHE), the government body responsible for protecting the nation's health and wellbeing and reducing health inequalities.



LSTM Professor Hilary Ranson provides entomological support to the PHE's Advisory Committee on Malaria Prevention in Travellers. Dr Nick Beeching, LSTM Senior Lecturer and Honorary Consultant at the Royal Liverpool University Hospital, is part of the PHE Imported Fever Service. LSTM Professors Laloo and Harrison sit on the PHE committee, which gives advice on the management of exotic envenoming in the UK.

PHE also partners in several research projects run by LSTM, including work led by Dr Tom Fletcher on viral haemorrhagic fevers.

NaTHNaC

The National Travel Health Network and Centre (NaTHNaC), commissioned by Public Health England, has the aim of protecting the health of British travellers. NaTHNaC seeks to improve travel health advice given by health professionals and provides reliable information to the public, health professionals, travel industry and national government. NaTHNaC works in partnership with network founders, which include LSTM.



Maternal, Newborn and Child Health

Maternal, neonatal and paediatric conditions continue to pose major global health risks, especially in lower and middle income settings. Complications around pregnancy and childbirth; infections such as with malaria, HIV and tuberculosis during pregnancy and severe acute malnutrition and undernutrition amongst children under the age of 5 still pose significant challenges despite progress made over the past years.

Every year, 295,000 women die due to complications during and after pregnancy, 2.6 million babies are stillborn, and 2.5 million newborn babies die. Most of these deaths occur in low- and middle-income countries (LMICs) and most can be prevented if effective, good quality care is available. LSTM's Centre for Maternal and Newborn Health (CMNH) is committed to ending these preventable deaths and improving the health of mothers and babies in LMICs.



CMNH conducts implementation research, to discover and share what, why, and how interventions work in 'real life' settings, to reduce maternal and neonatal mortality and stillbirths, and, to improve health and healthcare delivery. CMNH strengthens existing data collection systems, the use of data, and it develops new indicators and frameworks to evaluate the effectiveness of single or complex interventions. Over the past year, CMNH worked in over 20 countries across Africa, Asia and the UK; its portfolio included 23 programmes, with grants from 14 donors totalling more than £7.5 million.

Antenatal and Postnatal Care (ANC/PNC)

Antenatal and postnatal care are essential interventions for the health of mothers and babies. This year, CMNH has designed and delivered interventions that focus on improving ANC/PNC:

- A 5-day competency-based ANC/PNC workshop for healthcare providers has been delivered in Tanzania, funded by UNICEF and in Chad and Togo, funded by FOSAP and UGP through The Global Fund to Fight AIDS, Tuberculosis and Malaria programme. Following each workshop, selected participants are trained as Master Trainers, who cascade the training to their colleagues, ensuring sustainability.

- Development and delivery of a new one-day intrapartum care course in Zanzibar, funded by UNICEF. Participants practised context-specific scenarios while considering women's individual health needs and the importance of empowering women to have a positive birth experience.



Participants on the ANC-PNC course in Zanzibar

- Ongoing case control study in Togo, funded by the British Maternal and Foetal Medicine Society, to evaluate screening tools for infection during and after pregnancy.
- CMNH's Professor Mathai joined the expert advisory group for WHO-led study on Maternal Immunizations and Antenatal Care Situation Analysis and the WHO-PATH-led "Advancing Maternal Immunization" panel.

Skilled Birth Attendance

To reduce maternal mortality, women require access to skilled health personnel. CMNH completed a programme to improve the quality of care provided by Auxiliary Nurse Midwives in Pune district, India. This was partnered by the Foundation for Research in Community Health and supported by HT Parekh Foundation.

CMNH trained 38 doctors and nurses to become Master Trainers, who subsequently delivered training to 350 ANMs and their supervisors. Post-project evaluation found that it filled an



Auxiliary nurse midwives at a skills mall in Pune district in India

important gap in the district's capacity-building plans for this cadre. CMNH is now working with the Master Trainers to train ANMs and supervisors in a nearby district.

Emergency Obstetric Care (EmOC)

Emergency Obstetric and Newborn Care is an evidence-based care package designed to reduce preventable stillbirths, maternal and neonatal mortality and morbidity. This year, CMNH's 'skills and drills' EmOC workshop was delivered in the UK, Kenya and Nigeria, in programmes funded by DFID Kenya and Johnson & Johnson. In August 2019, CMNH trained Master Trainers in Kenya, to enhance their clinical and teaching skills in EmOC.

In Sierra Leone, the Centre delivered mentorship training to prospective mentors, in programmes funded by GOAL and Johnson & Johnson. The courses aimed to help mentors to support healthcare providers to apply lessons from EmOC training to the clinical arena.

The EmOC workshop was delivered in Kenya and Nigeria. It aimed to improve the quality of care provided to women undergoing operative obstetric procedures, including caesarean section. Participants were supported to formulate action plans for their facilities which prioritise implementation of learning for better clinical practice.

Newborn Care

Neonatal mortality accounts for 45% of all under-5 child mortality. This year, CMNH work in newborn care included:

- A population-based prospective cohort study funded by the European Commission in Ghana and Zimbabwe, which aims to assess the burden of diseases in infancy potentially preventable by maternal immunisation. The findings will be used to develop recommendations for the prioritisation of vaccines.
- A study to develop and test a novel package of community-based interventions targeting low birth weight (LBW) babies in Kenya.
- A partnership with LSTM's Professor Stephen Allen (see box text) to set up a Neonatal Nutrition Network in sub-Saharan Africa.

Quality of Care

Quality improvement (QI) is a critical component of CMNH's work. It is a member of the Global Maternal and Perinatal Death Surveillance and Response Technical Working Group and the Quality Equity Dignity Network and its long-term arrangement with UNICEF to provide technical assistance in Capacity Development on QI on maternal, newborn and adolescent health has led to a number of grants.

CMNH is currently supporting the Ministry of Health and Medical Industry in Turkmenistan to improve the quality of newborn care. The project, commissioned by UNICEF Turkmenistan, will promote the quality of newborns and child healthcare through implementation of QI, including strengthening facility-based quality of care for mothers and newborns and capacity-building of healthcare workers.

In December 2018, CMNH facilitated a WHO capacity-building workshop on the implementation of perinatal death audit with healthcare providers from Europe and Central Asia. CMNH also developed national guidelines for perinatal death surveillance and response for Malawi, supported implementation of perinatal death audit in Kenya and supported the Cambodian Ministry of Health in a national review of maternal deaths.

Staff also delivered two QI workshops at the National Midwifery School in Togo, funded by UGP through The Global Fund to Fight AIDS, Tuberculosis and Malaria programme. This training has also been delivered in Chad and Malawi.

Evaluation

CMNH has a successful track record of providing technical and methodological support to the design and delivery of evaluations of complex, large-scale health programmes in Africa and Asia. CMNH was commissioned by UNICEF to conduct the independent evaluation of the Health Development Fund in Zimbabwe, a multi-donor pooled fund.

CMNH was also commissioned by UNICEF India to evaluate their contribution to the Facility-Based Newborn Care

Programme in six states of India, with a focus on Special Newborn Care Units. The recommendations will be used to inform the Government of India's newborn strategy and strategies for UNICEF's 2018-2022 country programme. CMNH also conducted the performance assessment of UNICEF-supported Special Care Newborn Units (SCANUs) in 8 divisions of Bangladesh, commissioned by UNICEF Bangladesh. The findings will inform policy-makers and programme managers on key interventions needed within health facilities and communities to ensure newborns survive and thrive to reach their maximum potentials.

CMNH is currently conducting a formative evaluation of South Asia's Community Health Worker (CHW) policies and support systems. The evaluation, commissioned by UNICEF's Regional Office of South Asia, covers Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan and Sri Lanka. The CMNH team will produce country-specific analytical reports and a gender-focused report, highlighting prioritized measures that can be taken by government, UNICEF and partners to strengthen health policy and system support to optimize the contribution that CHW cadres can make to strengthening Primary Healthcare.

Paediatrics and child health

NeoNuNet (NEOnatal NUtrition NETwork) is a new initiative, led by LSTM's Professor Stephen Allen and Dr Helen Nabwera, to improve outcomes for highly vulnerable newborns in sub-Saharan Africa. Funded by a Confidence in Global Nutrition and Health Research Award under the Global Challenges Research Fund, it set-up a Network of 5 neonatal units in Nigeria and 2 in Kenya linked with experts from Newcastle, Aberdeen and Liverpool Universities and Imperial, London. The Network has established a database of all neonatal admissions over 6 months as a platform for supporting a broad range of future research, quality improvement in neonatal care and capacity-building in research.



Members of Neonatal Nutrition Network

The PREbiotics and SYNbiotics in infants in Kenya (PRESYNK) study

LSTM is partnering with the Children's Investment Fund Foundation (CIFF) on a new £2 million project in Homa Bay, Kenya. The study aims to assess whether probiotics and prebiotics, given as supplements to young infants, may improve gut health, and thereby nutrition and growth, through supporting the development of a healthy gut microbiome.

GCRF Action Against Stunting Hub

LSTM contributes to the £18m GCRF Action Against Stunting Hub led by the LIDC, the London International Development Centre. Experts from several different disciplines are joining forces to re-evaluate the cascade of factors driving stunting and how they inter-relate.

Gut health in children in the UK

Professor Stephen Allen leads a portfolio of investigator-led, Clinical Research Network and commercial research in gastroenterology and nutrition at Liverpool's Alder Hey Children's Hospital. An initial study of "First Milk" (bovine colostrum) in reducing intestinal inflammation and boosting nutrition in young people with Crohn's disease, funded by the NIHR Research-for-Patient Benefit programme, is underway. Professor Allen was also the Chief Investigator for Shield Therapeutics plc for a UK multi-centre of a study that confirmed the safety and tolerability and assessed pharmacokinetics of different doses of oral ferric maltol in children with iron deficiency.

Malaria in Pregnancy

The malaria epidemiology team, led by Professor Feiko ter Kuile, continues its research on maternal and child health with the LSTM-Kenya/Kenya Medical Research Institute (KEMRI) /US Centers for Disease Control and Prevention (CDC) collaboration in western Kenya. On average six PhD students are enrolled as part of these studies, and four students defended their thesis this past year.



KEMRI malaria lab team explain the mechanism of automated DNA extraction with QIAasympy to Professor Feiko ter Kuile - credit EDCTP

Professor Ter Kuile and Dr Jenny Hill are leading the new IMPROVE Consortium, co-funded by the EDCTP and MRC/DFID/Wellcome/NIHR Joint Global Health Trials scheme, which is conducting two multicentre trials of new regimens for the chemoprevention of malaria in pregnancy in HIV-infected and -uninfected pregnant women in areas of high drug resistance in Kenya, Malawi and Tanzania. Additional sub-studies on acceptability, feasibility, and cost-effectiveness are being conducted to provide evidence to inform subsequent policy adoption of either intervention should they prove efficacious, safe and well tolerated.

Dr Hill is leading a 3-year study in western Kenya in collaboration with KEMRI, CDC and LSHTM to explore the dynamics of the implementation of the world's first malaria vaccine as part of a multi-country evaluation in Ghana, Kenya and Malawi. Kenya launched the national malaria vaccination programme on 15 September 2019, and the team are interviewing health providers at each level of the health system on progress and caregivers on perceptions and experiences with the malaria vaccine.

The group also completed a 3-year trial in young children in nine hospitals in Kenya and Uganda. Results were beyond expectations and showed that three months of chemoprevention with monthly courses of a long acting antimalarial (dihydroartemisinin-piperaquine) is a promising new tool for the post-discharge management of vulnerable children recently admitted with severe anaemia, resulting in large reductions in the risk of post-discharge deaths or re-admissions. The results are likely to have policy implications in malaria-endemic areas in sub-Saharan Africa.

Dr Annemieke van Eijk and Professor Ter Kuile, in collaboration with other researchers, undertook the most comprehensive study of the impact of drug resistance on the effectiveness of intermittent preventive treatment (IPT) in pregnant women which was published in The Lancet Infectious Diseases. The study informed WHO policy on the use of sulphadoxine-pyrimethamine for the use of IPT in pregnant women. The team also lead a large study, involving other research groups, on the safety of artemisinin-based combination therapies (ACTs) in the first trimester of pregnancy. Results are currently under consideration by the WHO.

Following the successful completion of the first large-scale malaria chemoprevention trial in the Asia-Pacific region, showing monthly intermittent preventive therapy with dihydroartemisinin-piperaquine in the second and third trimester as a promising alternative to current policy of screening at first antenatal visit in areas of moderate-to-high transmission, and as published in Lancet Infectious Diseases, the team has been working with partners in Indonesia to support the Ministry of Health to pilot the intervention at scale. Phase-IV pharmacovigilance studies in Indonesia funded by MMV to further assess the safety of the artemisinin-based combination (ACT) dihydroartemisinin-piperaquine in women in the first trimester were concluded and results provided reassurance on the safety of ACTs in the first trimester of pregnancy, in line with the 2015 recommendation by WHO.

Emergency Obstetric Care (EmOC)

Most stillbirths, maternal and neonatal deaths occur in low- and middle-income countries (LMIC) due to complications, which are largely unpredictable and unexpected. In response, evidence-based interventions are bundled to form an internationally agreed and defined package called Emergency Obstetric Care (EmOC). LSTM's Centre for Maternal and Newborn Health conducted research to identify why women die, why stillbirths occur and why minimum indicators for EmOC are not met. A multicountry implementation study showed that a new 'skills and drills' training package for skilled birth attendants and strengthening of health facility capacity to provide EmOC saves lives. It was the first study to document a measurable increase in healthcare provider capacity, increased number of women recognised needing and receiving EmOC, and reduction in maternal mortality and stillbirths. This approach has been scaled up in all participating countries and adopted by 5 new countries.



Public Engagement

Over the past year lots of local, regional and national activities were undertaken to engage multiple audiences with the work done at LSTM. To make audiences think about science and its daily relevance to them and at the same time be challenged by the public is of vital importance to researchers.

Public tours of LSTM

LSTM began hosting monthly tours of its research facilities, bringing together staff and students from the Library, Departments of Vector Biology and Tropical Disease Biology, Centre for Snake Bite Research and Interventions, Dagnall Laboratory and Centre of Maternal & Newborn Health. Participants are mainly from local history groups, the University of the Third Age and Network 55+. The tours aim to coordinate the many incoming requests to visit LSTM's insectaries, laboratories, herpetarium and historical archives.



Participants of the LSTM Tour witness a venom extraction at LSTM's herpetarium

"Absolutely amazing! I had a fab time learning about all the history of LSTM. The archive and the lab were super cool and visiting the venom room was such a privilege. To be honest I wasn't aware of what goes on here and what work you do. I think you do incredible work at preserving the items in the archive. Great job."

LSTM at BlueDot Science Festival

For the third year running LSTM presented at the BlueDot Science & Music Festival at Jodrell Bank.

Professor Mark Taylor of the Department of Tropical Disease Biology returned to BlueDot to deliver a prominent Dot talk entitled The Light and Dark Side of the Symbiont.

Clinical Sciences' Dr Shevin Jacob and Dr Tom Fletcher drew parallels between what happens when sepsis spreads in the body and what happens when an infectious disease such as Ebola spreads in a community during an outbreak in their Dot talk.

Across the weekend, the Club Tropicana stand discussed challenges faced by midwives and obstetricians in low to middle income countries with CMNH, and teams from Tropical Disease Biology and Vector Biology departments wowed festivalgoers of all ages with mosquitoes and parasites, and how to wrangle a snake. The team were joined by the Snake Wallahs, who paraded the fields and arena with a 16-foot spitting cobra puppet leading the crowds to the Club Tropicana stand.



The Snake Wallahs perform in front of the LSTM stand at BlueDot 2019

BBC Merseyside's SciFri

SciFri (Science Friday), originally an LSTM initiative, is a BBC Radio Merseyside segment involving researchers from LSTM, Liverpool John Moores University and the University of Liverpool, taking place every Friday morning. Researchers are being interviewed about their work and interests in an informal setting. Over the past year numerous LSTM academics took part in this increasingly popular segment of the breakfast show.

"I love to know about the exciting research happening in my city, I like SciFri very much."

Feedback from an audience member at Pint of Science 2019.



LSTM's vector biologist Lee Haines during a SciFri session with BBC Merseyside's Tony Snell

Pint of Science

For the third year running Liverpool hosted its version of Pint of Science, an annual festival that brings engaging science and latest research findings to pubs and bars across the world. During Journey to the Tropics at Oh Me Oh My, LSTM's Terry Kana spoke about the enablers and challenges to providing maternity care in low-resource settings, exploring the challenges that nurse midwives face in Bangladesh and Malawi. Dr Tom Wingfield spoke about the broader impact that poverty has on communities' health and wellbeing, within the context of TB. Joanna Furnival-Adams argued that reducing entry of mosquitoes into the home as a form of vector control, should not be overlooked.

FameLab UK finals

Dr Samantha Donnellan from the Department of Tropical Disease Biology made it to the final of FameLab UK, held during the Cheltenham Science Festival. Samantha's engaging style and effective use of props to present her work studying drug action on intracellular Mycobacterium tuberculosis in an understandable way resulted in her reaching the final of the competition.

FameLab is a communications competition designed to engage and entertain by breaking down science, technology and engineering concepts into three-minute presentations. Contestants from around the world take part armed only with their wits and a few props to enlighten and excite the audience.

Big Bang North West

The Big Bang North West showed young people in England's Northwest region the exciting science career opportunities available to them by bringing classroom learning to life. A team from LITE and the Department of Vector Biology, led by Zachary Stavrou-Dowd, engaged with 390 school children who were in awe at the various parasites and mosquitoes on display.

Bollington Festival

Staff and students from the Departments of Tropical Disease Biology, Vector Biology and International Public Health took Club Tropicana to the Bollington Festival, in the town of Bollington near Macclesfield. The visitors to the stand saw mosquito and tsetse demonstrations, gruesome parasites in jars and fact cards to inform. Terry Kana also joined the team with demonstrations of the tools used to improve the health of mothers and new-borns in low- and middle-income countries.

"Amazing information about mosquitoes and we'll look on the website when we return home to find out more about the snakes! Thank you."

Human African trypanosomiasis (HAT)

Human African trypanosomiasis (HAT), caused by trypanosomes transmitted by tsetse flies, is a neglected tropical disease threatening rural populations in 20 countries across sub-Saharan Africa. Devastating epidemics of HAT have occurred over the last 100 years; the most recent killed 500,000 people a year at its peak. A WHO-led programme aims to eliminate HAT as a public health problem by 2020. LSTM researchers have developed cost-effective methods of tsetse control, including Tiny Targets and insecticide-treated cattle, solving some screening programmes shortcomings. It led to vector control becoming an essential component of the global programme to eliminate HAT.



Innovation, Discovery and Development

Innovation and translation are at the forefront of work at LSTM as it aims to discover and develop, then go forward with implementation of its innovative ideas. In doing so, LSTM considers itself unique in spanning the translational pipeline from discovery to implementation.

Centre for Drugs and Diagnostics

LSTM's Centre for Drugs and Diagnostics (CDD) comprises an experienced multi-disciplinary group of experts working together to develop new drugs and diagnostics. Using state-of-the art laboratories and equipment, including Category 3 laboratories, medicinal chemistry laboratories, analytical laboratories, robotic liquid handling and high content imaging platforms CDD works with industry, academia and other NGOs to discover, develop and deliver novel therapies and diagnostics against a range of pathogens.



Clinical candidates to treat filariasis

Researchers of the anti-*Wolbachia* (A-WOL) consortium have continued two major drug development projects for short-course curative treatments of the filarial diseases, onchocerciasis (river blindness) and lymphatic filariasis (elephantiasis).

The novel approach of the consortium is to target the filarial symbiont, *Wolbachia*, leading to a safe, gradual cure of filarial infection. A short-course anti-*Wolbachia* treatment delivering curative activity would be a radical new tool to accelerate global elimination targets of filariasis.

With partners at AbbVie and Drugs for Neglected Diseases initiative, the A-WOL clinical candidate, ABBV-4083, has successfully completed phase I first-in-human testing. Data from the early clinical study is now being used to design a proof-of-concept phase II clinical trial enrolling onchocerciasis patients in Ghana. The trial is expected to commence in 2020.

In partnership with Eisai and funded by The Medical Research Council, the A-WOL candidate, AWZ1066, commenced formal preclinical development in September 2018. A-WOL researchers visited the Eisai production facility in Visakhapatnam, Pradesh, India in July, where scale up manufacture of the drug has been undertaken for toxicology studies. The preclinical data package will be complete in March 2020 and will support application for investigational new drug status, transitioning AWZ1066 into early clinical development in 2020.

Antibodies to fight flu

This year marks a sombre anniversary: the centennial of the 1918-1919 Spanish influenza pandemic, which claimed nearly 100 million lives worldwide in one of the deadliest disease outbreaks in recorded history. Many viruses, including the influenza, recognize sugar containing receptors in human lungs to infect and cause disease.

As antibodies and their fragments are an established class of clinically successful molecules, Professor Richard Pleass's laboratory have been engineering sugars onto antibodies to block the virus.

In an article published in the Journal of Immunology, his group have shown, using WHO standard assays, that leads, developed at LSTM, can block highly divergent viruses including the viruses responsible for the 1918-1919 pandemic. They are currently working with colleagues at Porton Down to further test the efficacy of lead compounds and are seeking commercial partnerships for licensing.

Diagnosing pneumonia by breath analysis

In 2018-2019 the diagnostics group, led by Dr Emily Adams, completed enrolment to the BreathSpec study. More than 1250 patients with suspected bacterial pneumonia or bacterial sore-throat were recruited in the Liverpool region and 3 other UK NHS Trusts. The novel BreathSpec technology is being tested to identify markers of bacterial vs viral chest infections using only a breath sample. This ability to diagnose people who do not require antibiotics for a viral infection could revolutionise our prescribing methods and using a non-invasive breath sample means this could be performed anywhere.

Improving the diagnosis of tuberculosis

Tuberculosis is the most frequent cause of adult death due to infection. Despite technical developments in the last decades, diagnostic tools are still inadequate, and patients need to travel to reference laboratories for testing. Not surprisingly, in 2018 one third of the cases were missed by national control programs. LSTM's Professor Luis Cuevas has recently completed EDCTP-funded studies, such as in Nigeria, to develop novel and efficient diagnostic approaches, demonstrating that acute

phase markers can triage patients with a high and low risk of TB, allowing signposting patients to further confirmatory tests or alternative diagnostic pathways. These studies also generated data new diagnostics performance, which will inform the WHO's process for diagnostic endorsement late 2019.



Menstrual cup innovation

Menstrual cups are insertable bell shaped vessels made of silicone, rubber, latex or elastomer and one can last up to 10 years. This innovation collects rather than absorbs menstrual blood, requiring emptying and reinsertion every 4-12 hours depending on flow. Although first available in the 1930s they are only now being recognised as a cost-effective, non-polluting alternative to single-use sanitary products. Professor Phillips-Howard and team evaluated the acceptability, use and safety of these cups among adolescent schoolgirls in rural Kenya, supported by a grant from the UKRI's Joint Global Health Trials Initiative.

Cups cost about 6% that of using 12 single-use sanitary pads per period, since one cup can last over 10 years, and create only 0.4% of the plastic waste generated by single-use pads. These environmental and economic costs will resonate with the 1.9 billion women of menstruating age globally, and among aid and development agencies providing products to replace unhygienic materials used by women and girls in impoverished settings around the world. The article prompted widespread press and social media interests, with over 140 news/media sites discussing the findings.

Innovative vector control

The need for new tools to prevent vector borne diseases by targeting the insects that transmit the pathogens is widely recognised but there is less consensus on how these new tools should be evaluated to determine their public health value.

One of the largest ever trials of vector control tools is ongoing in Uganda; the LLIN Evaluation in Uganda Project (LLINEUP) is employing an innovative study design, embedding a randomised controlled trial within a routine bednet distribution campaign to evaluate the public health value of nets containing the traditional pyrethroid insecticides plus the synergist piperonyl butoxide (PBO). The scale of the trial affords a unique opportunity to evaluate PBO nets across different epidemiological settings. The large-scale trial embedded within

could be a paradigm for future assessment of malaria control interventions. It may also help inform national policy on bednet use

Currently policy adoption at the global level requires at least two large scale clinical trials, such as the LLINEUP trial; these are expensive and time consuming and it can be difficult to extrapolate results from one setting to another. In a project funded by the Bill and Melinda Gates Foundation we are looking at innovative new ways to evaluate vector control tools by directly measuring the impact on the insect vectors and using mathematical models to translate this to predicted clinical impact. If successful, this approach would greatly accelerate the deployment of urgently needed preventative tools for diseases such as malaria.

Maintaining the importance of bed nets in the control of diseases such as malaria remains a priority, particularly given the growing issue of insecticide resistance. LSTM have identified a simple solution by demonstrating that insecticidal net barriers on the bed net roof greatly improve its efficacy. With the extra panel being above the main body of the net and out of the reach of children and not coming into contact with the bed's occupant allows the "Barrier Bednet" to utilise a whole range of insecticides not currently used on traditional nets.



The fight against vector borne diseases requires extensive knowledge of the vector and, where appropriate, the opportunity to modify their biology to better understand their ability to transmit pathogens. The genetic modification of mosquitoes has been further developed at LSTM, taking inspiration from principles related to targeted drug design, "ReMOT Control" (Receptor-Mediated Ovary Transduction of Cargo) exploits proteins that are transferred into the ovary of insects. These proteins are harnessed to deliver desirable cargo to the developing ovary, thereby enabling genetic modification of the insect and avoiding the need to microinject the embryo to deliver these molecules. The 3.5 year funded BBSRC grant which brings together researchers from LSTM, the University of Liverpool and Cambridge University, to expand the tools compatible with ReMOT Control and develop a flexible and efficient toolkit for the genetic manipulation of insects.



Professor Nick Casewell looking at how antibodies recognisebind to snake venom proteins

Health Innovation in a Virtual Environment (HiVE)

LSTM has a long history of working in the field across the world. We know from this experience that there is no shortage of talented individuals motivated to make a difference in their communities. However, there is a shortage of opportunities for them to reach their full potential. LSTM's Health Innovation in a Virtual Environment (HiVE) could be the key to unlocking that potential.



HiVE aims to identify innovative, fresh thinking and applicable ideas that address global health issues. By creating a multi-disciplinary 'College of Experts' underpinned by a key skills curriculum we can develop ideas from an initial spark to a refined and confident business plan or grant proposal. Designed to specifically encourage participation from low-middle income countries, HiVE is delivered entirely through an innovative virtual platform, in a flexible manner so that participants don't have to leave their jobs, family or country to benefit from the expertise of dedicated mentors and entrepreneurs across various global health fields.

Innovation in snakebite therapy

This year has seen a £9 million investment in snakebite research from the UK Department for International Development, leading to the formation of a new global research consortium, the Scientific Research Partnership for Neglected Tropical Snakebite (SRPNTS). Bringing together partners from five countries it sees LSTM joining forces with the International AIDS Vaccine Initiative (IAVI) to discover and develop novel monoclonal antibody (mAb) therapies to significantly improve the efficacy, safety, and affordability of snakebite treatment in India and Africa. With IAVI's experience in researching neutralizing antibodies against HIV and LSTM's Centre for Snakebite Research and Innovations' track record in the development of antivenom it is hoped that the partnership will bring about new snakebite therapies, applying state-of-the-art science in monoclonal antibody discovery and recombinant technology.

Polymerase Chain Reaction (PCR) diagnostic test

2019 has been an exciting year within the Clinical Diagnostic Parasitology Laboratory (CDPL) with the evaluation, validation and verification of a diagnostic PCR for the detection of faecal parasites. Working in conjunction with LSTM's diagnostic research team this diagnostic test will be launched in early 2020. The test is unique to clinical diagnostic settings within the UK as it is an in-house, non-commercial test that detects a number of protozoa, coccidia and helminth species of faecal parasites within one multiplex PCR.

This test will sit alongside current concentration microscopy and helminth culture technique to greatly increase the sensitivity of faecal parasite detection in samples received from the users of the CDPL diagnostic service around the UK.

Snakebite research

Snakebite is perhaps the most under-researched and under-resourced high emergency medical condition worldwide.. In sub-Saharan Africa, lack of access to effective antivenom treatment leads to ~32,000 deaths and 90,000 disabilities annually, predominately in impoverished rural, remote communities. It is the most economically-productive and educationally-vulnerable 10 to 30-year olds that suffer most from this neglected tropical disease (NTD). LSTM's unique research mission is to improve the treatment of snakebite focussing on sub-Saharan Africa and the Indian sub-continent. LSTM was the first to raise the plight of African snakebite victims; accumulate the requisite resources, expertise and networks to design, test and deliver new antivenoms for West Africa; identify that snakebite causes chronic psychological co-morbidity. LSTM has been instrumental in organising global advocacy efforts that resulted in key policy changes in National and International Health Agencies, including WHO's recent classification of snakebite as a priority NTD.





Photo credit: Lee Booth, LSTM

Health Goals Malawi

Coach Frank Gulani leads a football game of ‘Body vs Disease’, part of the Kafukufuku festival at the Chikwawa sports ground, Chikwawa, Malawi.

The training is part of Health Goals Malawi – a joint project of Liverpool Football Club (LFC) Foundation, LSTM’s Centre for Capacity Research, Malawi-Liverpool Wellcome Trust Clinical Research Programme (MLW) and PSI.

Players must listen carefully to the coach – if he calls a word out that is a disease, players must be on the left of the cones; if he calls out a part of the body they must be on the

right. If someone jumps too early, or forgets to jump, they are eliminated, until there is only one person left standing. With no need for any equipment, this game is popular with coaches who have seen their participant numbers double since starting the project, while the words in the game help start a conversation at the end of the session – how can we protect the body against these diseases?

After the training, coach Frank said: “Now, if you finish a session without telling them any health messages – they are going to ask you, ‘Coach, are you not going to tell us any health message?’ It’s because they are enjoying it, so it’s great for us.”



Foundation

THE CLUB'S OFFICIAL CHARITY



LSTM

CENTRE FOR CAPACITY RESEARCH



Malawi-Liverpool-Wellcome
Clinical Research Programme



psi

Malawi

Health Policy and Health Systems Research

To improve prevention and treatment of many diseases, new products and interventions require knowledge of their effective implementation and an understanding of their impact through constant monitoring and evaluation.

LSTM's emphasis on product development alongside translational and policy research with special focus on health systems and capacity strengthening resonates strongly with institutions; governments and their ministries; funding bodies and partner organisations across the globe.

Health Policy and Health Systems Research at LSTM includes a strong focus on taking interventions from regulatory approval through to field implementation.

This encompasses the activities that help develop practical solutions to health needs and rights. It incorporates the spectrum of research that delivers policy-relevant evidence and includes operational, implementation, and health systems research.

It is part of the value chain taking knowledge from Discovery and Translation and moving it into policy and practice. These research domains are required to develop and synthesize a robust body of evidence to help drive policy and practice for health amongst poor and vulnerable populations in the developing world. It requires expertise from a range of disciplines to combine and integrate scientific, technological, economic and social insights.

Centre for Health Systems Strengthening (CHESS)

Established in Jan 2019, CHESS brings together internationally valued researchers with interests and expertise centred on several of the health systems building blocks, including health workforce strengthening, information and evidence, health financing and governance and the relationships between them, as well as concerns that cut across the whole system, such as capacity strengthening, community health and gender equity. They are linked by a common systems approach to health and our commitment to values of social justice, equity, people-centred systems, capacity building, trusting partnerships and research for public health impact. There is a focus on Health Systems Research (HSR) and health services research, which also include collaboration with actors beyond health, including

education and community-based organisations. CHESS mission is to strengthen and strategically expand high quality research and teaching on health system strengthening within LSTM and with the best global partners.

The research takes a systems- and people-centred-approach that is concerned with the complex interactions between the different health systems building blocks within specific contexts, in order to provide evidence for improving the functioning, equity and effectiveness of the system as a whole, and is inherently multidisciplinary. Disciplinary influences include social sciences, implementation research including a focus on scale-up, development studies, epidemiology and management sciences. CHESS has grants well in excess of £50 million, a growing staff body of researchers, programme managers and PhD students, and is able to demonstrate significant impact. Key asset is the broad and deep trusting relationship with strategic southern partners, which has been critical to both winning grants and maximising impact.

Research capacity strengthening

LSTM Centre for Capacity Research's DELTAS Learning Research Programme (LRP), part of the DELTAS Africa initiative, produces research-based learning about how to train and develop world-class researchers, foster careers and collaborations, and promote research uptake. In the programme, the Centre for Capacity



Research (CCR) is exploring four thematic research strands, three of which within the frame of a PhD fellowship. The thematic strands are - equitable career pathways, research training, knowledge translation, and consortia management.



DELTA Africa AGM in Senegal. From left: LSTM's Justin Pulford and Imelda Bates, Millicent Liani (DELTA PhD student, CCR), Nadia Tagoe (DELTA PhD student, CCR), Pierre Abomo (TRYP-ELIM-BANDUNDU Post-doctoral research associate, CCR), Abiola Aiyenigba (DELTA Research Assistant, CCR)

The Centre is embedded in four GCRF programmes totalling £20million and within these diverse programmes of research, spanning conservation agriculture, One Health, vector control, informal settlements, CCR is working to generate high-quality robust evidence to aid the design and evaluation of capacity strengthening initiatives. This is done through the development of specific solutions to improve efficiency whilst ensuring that new knowledge is created and that the initiative is sustainable for the future.

CCR is strengthening the capacity of national disease control programmes especially in very challenging contexts. With the National Program for the Control of Sleeping Sickness in the Democratic Republic of Congo (PNLTHA), CCR is developing a capacity building plan for PNLTHA staff and identified capacity strengthening interventions for the next 24 months.

Working closely with IVCC, CCR is investigating the enablers and barriers, and lessons learnt to achieve sustainable Good Laboratory Practice (GLP) certification in African vector control product testing facilities. The lessons learnt from this research will be applied to other collaborating African trial facilities being supported by IVCC to help them develop a strategy, action plan

and progress indicators for achieving and sustaining their GLP certification.

GCRF ARISE (Accountability for Informal Urban Equity) Hub

Transforming the lives of marginalised people in informal urban spaces is vital to accelerate progress towards the Sustainable Development Goals. This entails tackling complex, interrelated challenges of poor health, unequal access to services, insecurity and weak accountability.

The ARISE Hub is a new research consortium led by LSTM, working with 11 partners in low- and middle-income countries (LMICs) and the UK. It aims to enhance accountability and improve the health and wellbeing of marginalised people living and working in informal urban spaces. To transform the quality of life in these spaces, a new understanding is required of how to strengthen accountability for effective services and responsive health systems, across a range of public and private, informal and formal actors. Action must be coordinated at many levels to tackle the root causes of unequal access to services and opportunities.

Viwandani village, Mukuru informal settlement, Nairobi, Kenya



Launched in January 2019 and funded by UK Research and Innovation's Global Challenges Research Fund, ARISE will run for five years. Initially, it will work in Bangladesh, India, Kenya and Sierra Leone and uses a Community Based Participatory Action Research approach, which involves conducting research in a way that involves community members in the research process, including developing, testing and evaluating strategies for change. Within this approach it incorporates methods and concepts from across multiple disciplines, including social sciences, urban studies and planning, economics and epidemiology.



Community map of informal settlement in Dhaka, Bangladesh

Evidence synthesis

The year saw the launch of the Research, Evidence and Development Initiative (READ-It), a six year, 7 million-pound grant to LSTM's Professor Paul Garner and Programme Manager Paula Waugh and Professor Taryn Young of the University of Stellenbosch. The team developed a number of new programmes with partners in Sri Lanka at the University of Colombo, with the TB Union in Delhi, and the University of Zambia, and existing links with the



Cochrane Effective Practice and Organization of Care Group and the EPPI-Centre at University College were re-affirmed.

The team was also part of the WHO guidelines for treatment of human African trypanosomiasis, the PAHO Histoplasmosis Guideline Group and the WHO Plague Guideline Group. A substantive qualitative synthesis of being HIV positive and staying on antiretroviral drugs in Africa was completed, and several Cochrane reviews published, including the Liverpool team completing PBO nets for malaria, an update of albendazole for filariasis, an update of the typhoid vaccines review, and an update of the iconic review of impregnated mosquito nets for malaria.

Monitoring, evaluation, training and research (METRe)

The METRe group is a leading unit for monitoring and evaluation (M&E), operations and implantation research in the UK.

The group has developed a Resilience Index and Health System Stress Index so that the concept of health systems resilience could be measured and investigated empirically.

The bulk of METRe's work concerns using implementation science methods to improve programs, health systems and related policy. An example of this would be the group's work with LSTM's Centre for Neglected Tropical Diseases, in which they assessed mass drug administrations (MDAs), clearly showing that the current approach to use administrative records of MDAs was inaccurate, the topic of a paper published in PLoS NTDs in summer 2019.

An application of the Annealing Technique to assess Child Health Days in sub-Saharan Africa showed the same. Both pieces of research affect policy both in terms of service delivery and program management.

METRe assessed the West Nile Refugee program in Uganda, during the summer, highlighting how the group link with humanitarian work to strengthen the health system funded by UNHCR and other donors. Similarly, METRe's work with UNICEF in M&E continues to aid them to the support national governments to appraise their health policies. Most recently METRe has worked in Zambia, where the Permanent Secretary accepted the assessment of their MDG Initiative and asked for support in their program planning using new priorities.

LSTM's Inaugural Athena SWAN outstanding contribution award

This year LSTM launched the Athena SWAN outstanding contribution award to recognise individuals who have gone above and beyond their normal role in promoting gender equality within LSTM. In total there were 20 nominations and, following an independent assessment, the winners are Gala Garrod, Natalie Lissenden, Katherine Gleave for their organisation of the Equality in Science Symposium 2019 and the runners up are Lee Haines, Agnes Matope and Eve Worrall for their work on equity within the workplace in terms of fixed term contracts and the gender pay gap analysis. LSTM would like to congratulate all nominees and winners and is looking forward to seeing further nominations for this annual award.



From left, winners Gala Garrod, Natalie Lissenden and Katherine Gleave

Rebuilding Health Systems

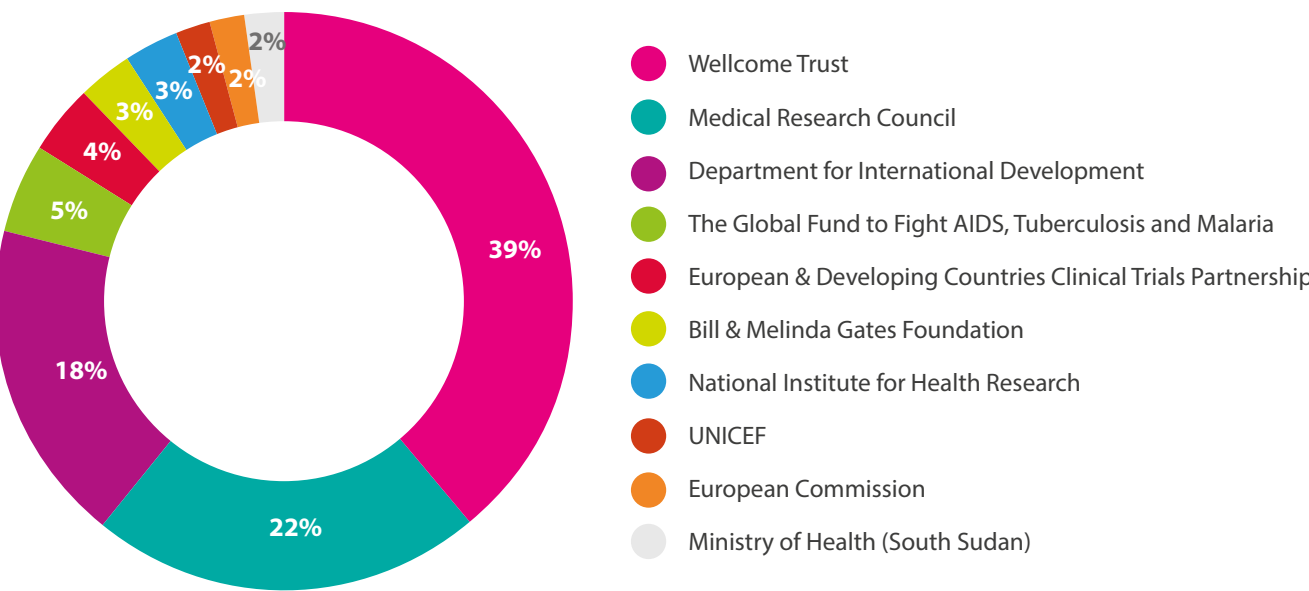
Fragility and conflict present a critical development challenge, eroding efforts to build healthy, equitable and prosperous societies. In these settings, evidence is critical to develop and sustain stronger and more resilient health systems. LSTM's research, through the ReBUILD research consortium, which included strategic partnerships, capacity strengthening, innovative research and 75 peer reviewed articles, has informed global policy and practice through engagement and citation at the highest level globally e.g. in World Health Assemblies and global working groups. It also had impact on national policies such as health worker policies in post-Ebola Sierra Leone.



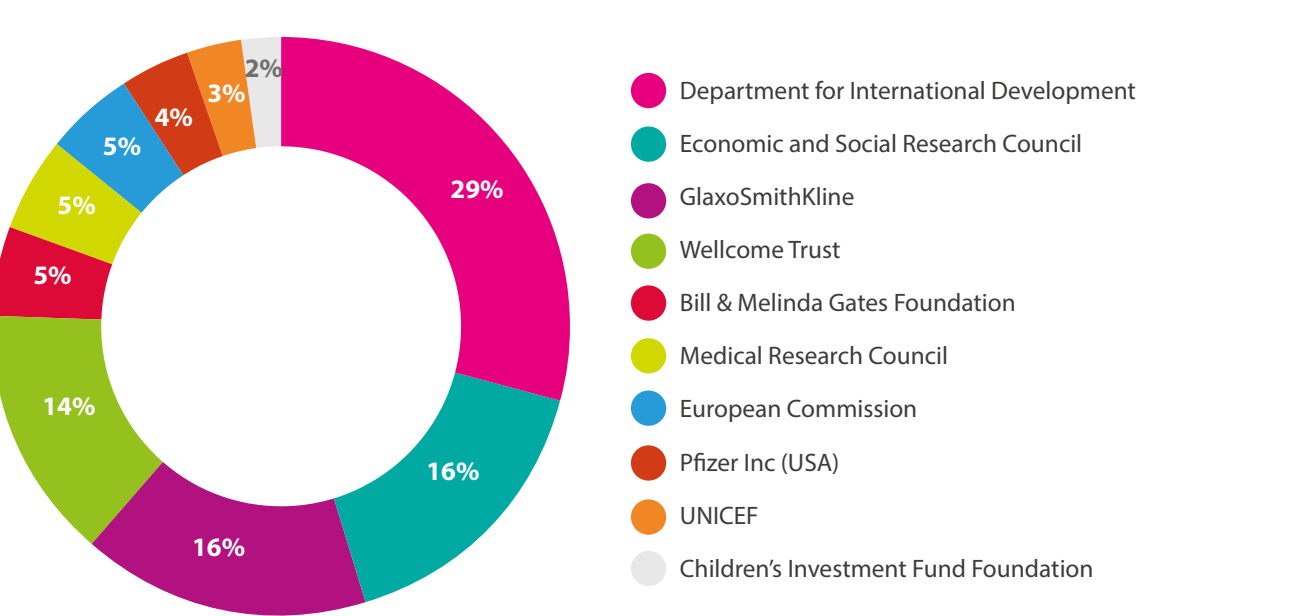
LSTM's Top Research Funders

The graphics below show the top funders in terms of total contract value (by ultimate source of funding) for LSTM during financial year 2017/18 and 2018/19. *Source: Converis*

Top 10 research funders (Grant research award amount) - FY 2017/18



Top 10 research funders (Grant research award amount) - FY 2018/19



Research Management Services

LSTM's Research Management Services (RMS) is leading the way on financial capacity strengthening and is making a difference in how LSTM delivers overseas projects and supports its global partners.

Development of a new grant management "standard"

Led by the African Academy of Sciences (AAS) and more than three years in development, a new African Standard was introduced in June 2018 aimed at improving grant management across African institutions. The Good Financial Grant Practice (GFGP) standard was developed in consultation with a wide variety of stakeholders from grantees, grantors, and auditors and it is hoped the standard will eventually become globally accepted by the International Standards Organisation (ISO).

LSTM staff were involved in the development of the standard from an early stage. Director of Finance, Duncan Preston, contributed to early versions and the Head of RMS, Helen McCormack, participated in the GFGP Accreditation Scheme that was simultaneously developed to ensure GFGP retains high standards. Helen McCormack is now a member of the GFGP Scheme Governance Committee, an independent external Committee, hosted by AAS to ensure the GFGP Standard is promoted and becomes globally accepted. The Committee has recently agreed the selection of certified bodies, which will provide the accreditation to institutions to prove that they meet the rigorous requirements of the GFGP standard. The standard has four different levels of compliance: bronze, silver, gold and platinum so institutions can work towards a higher level if they wish to improve their existing accreditation.

GFGP accreditation provides institutions with robust, externally accredited and readily available evidence that they are sufficiently financially capable of running and administering grants. It is hoped that in the future this will replace the need for funders/grantors to conduct regular due diligence as current practices are burdensome to institutions, with grantees experiencing multiple assessments in varying formats.

Financial Assurance Fund awards

In January 2019 LSTM was awarded three NIHR Financial Assurance Fund (FAF) grants, two of which are being delivered by RMS. NIHR established these grants to enable financial capacity strengthening in partner institutions and although modest in value at £50,000 for each group, they have far reaching impact as they are used to target and support financial teams. LSTM FAF projects were awarded under the IMPALA Global Health Research Unit for Epilab, Sudan, and Reach Trust, Malawi. The second RMS led FAF project was awarded under the ASRG Snakebite Research Group for the Institute of Primate Research, Kenya, and the University of Bayero, Nigeria.

RMS is delivering the FAF projects with a programme of work established for improvements in the target areas, with an African financial consultant also supporting the involved institutions to implement the enhancements needed. FAF projects support the targeted institutions to be able to apply for GFGP accreditation and three of the four are on track to do so in early 2020. Sudan has been delayed due to the civil unrest in the country but is now starting the GFGP FAF developments and should be able to apply for accreditation by June 2020. There is already evidence from the ASRG that the FAF award has directly led to the award of other external funding to the ASRG LMIC partners, a hugely significant benefit from the FAF activities.

The LSTM RMS success in the FAF bids was built around the targeted goal of achieving GFGP standard, minimum bronze level. This approach was highly commended by NIHR and has also been used by other UK universities with RMS providing technical assistance to them on how to implement this GFGP/FAF model. RMS has hosted a number of visits from NIHR and a Senior Advisor to AAS to discuss how we are implementing FAF using the GFGP standard, and they have acknowledged that LSTM is leading the way with this type of financial capacity building.



The Research Management Services team

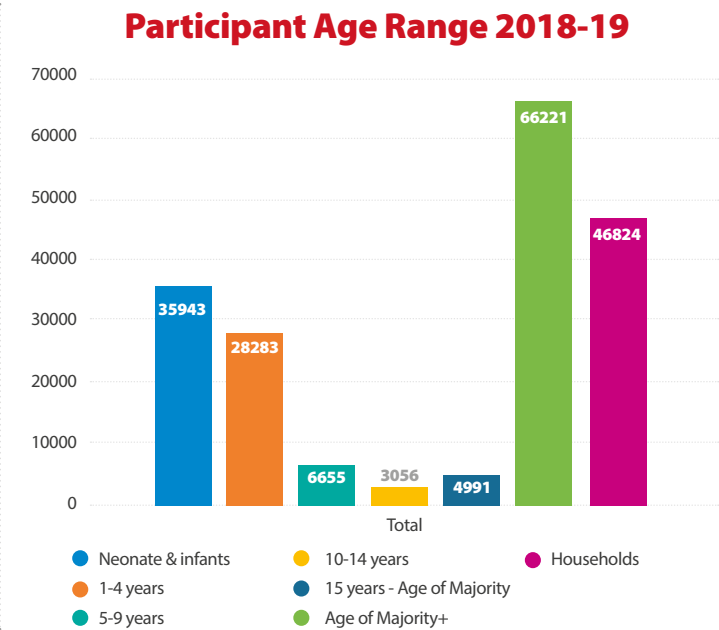
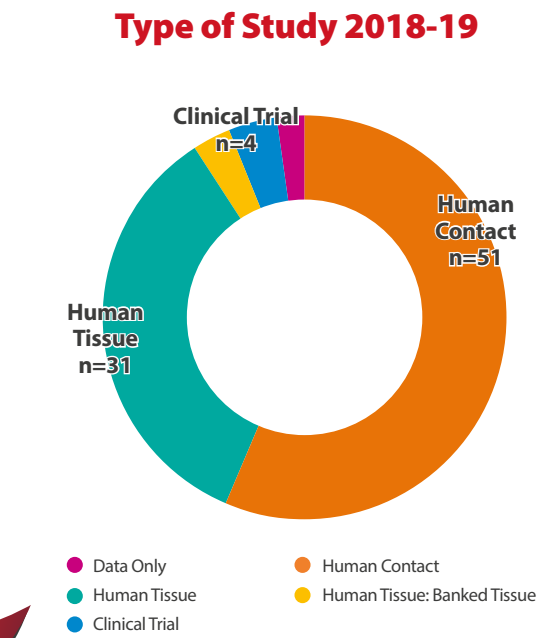
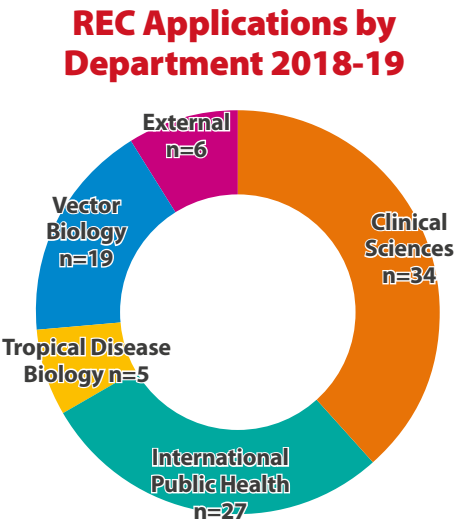
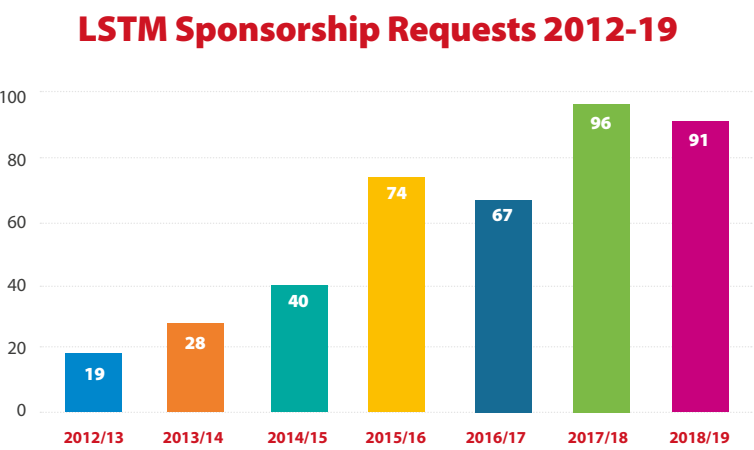
Research Governance and Ethics

LSTM's Research Governance and Ethics Office provides a fully integrated system which ensures regulatory and ethical approvals are in place prior to and during the conduct of LSTM sponsored research. The team ensures research teams and participants are fully supported and are given advice on how best to comply with the various regulations required to conduct safe and ethical research.

The office coordinates the work of LSTM's Research Ethics Committee (REC), which protects the rights and welfare of people participating in LSTM studies. Over the past year, LSTM REC reviewed studies that will recruit 200,000 participants, including 80,000 children. It is the Committee's responsibility to ensure that the contribution of participants to LSTM research programmes is safe, voluntary, and meaningful, and that research is conducted to the highest standards of research ethics.

The Research Governance Oversight Committee (RGOC), coordinated by the Research Governance and Ethics Team, provides the forum for the discussion and ongoing management of research governance sponsored by LSTM. Over the past year, RGOC oversaw 91 applications for LSTM sponsorship and indemnity. This incremental trend, driven by the successful integration of the LSTM Research Ethics and Sponsorship application process and enhanced Quality Control processes, represents a 36% increase from the 67 applications received in 2016-17.

Earlier in 2019, the office achieved a renewal of its US Federalwide Assurance (FWA) for the Protection of Human Subjects accreditation for 5 years up to 2024.



Research Support: Developing a Translational Research Pathway

LSTM's Research Committee (RC) is involved in shaping and implementing LSTM's research strategy towards the goal of improving the health and wellbeing of patients living in poor communities. It does so by advising LSTM's Management Committee on the strategic direction of research, identifying priority areas for research, as well as developing and promoting policies and practices that stimulate research programmes in agreed areas.



Professor Giancarlo Biagini - Chair of the Research Committee

Translation research, which aims to "translate" findings in fundamental research into medical practice and meaningful health outcomes, is at the centre of LSTM's strategic plans for the foreseeable future whether it be research, estates, administrative support or education and training. Over the past 3 years, RC has developed a translational research pathway that offers training and funding opportunities from PhD level, through to postdoctoral fellows and to more senior established principle investigators (PIs).

At the PhD level, RC established the MRC-funded **Translational and Quantitative Skills Doctoral Training Programme in Global Health**, in collaboration with Lancaster University. The programme seeks to train the next generation of leading "bridge" scientists working in translational research in Global Health. The programme currently trains some 30 students and its success was acknowledged by the MRC and awarded further MRC funding for an additional ~16 PhD studentships.

RC was again successful in securing funding for the next stage of the career pathway by receiving an **MRC Skills Development Fellowship** award. This programme, which will run for 6 years in collaboration with Lancaster University, is focused on training of PhD graduates in translational research with an emphasis in quantitative skills. Three fellowships were awarded in 2018 and in 2019 further fellowships were awarded to Dr Sumona Datta and Dr Julie-Anne Tangena.

RC recognise that the transition from postdoctoral researcher to an independent researcher is a very difficult and a critical stage that requires support. For this reason, it introduced the **Director Catalyst Fund (DCF)**. The DCF is an internal programme, funded through a combination of LSTM's own budgets and the Wellcome Trust. It is intended to support high-quality research projects, especially from early career researchers, requiring preliminary work or feasibility studies to a point where they are competitive for external funding. This year's successful awardees are Drs Alasdair Hubbard, Ian Patterson, Victoria Watson, Kim Ozano, and Lee Haines.

LSTM's RC and Research Management Services (RMS) also support junior and established PIs to generate proof-of-concept data for translational research through the **MRC funded Tropical Infectious Disease Consortium (TIDC) Confidence in Concept award (CiC)**.

In 2018, the TIDC secured further funding from the MRC, which graded the LSTM-run scheme as HIGH, the highest attainable evaluation. The TIDC has been leading the way in turning fundamental discoveries into improvements in human health and economic benefit for tropical diseases since its establishment in 2013. The Consortium brings together much of the UK's expertise in tropical infectious diseases into a single translational partnership from LSTM, London School of Hygiene and Tropical Medicine, the Jenner Institute at Oxford University and Public Health England. TIDC is strategically placed to deliver an unprecedented portfolio of domain specific expertise in all the key research areas of interest.

Over the past five years, the Consortium has received around £2.8 million that realised about £40 million follow-on funding from 31 projects. Follow-on funding has been received from MRC, Innovate UK, Department for International Development, Wellcome Trust, NHIR, and international funders e.g. Bill & Melinda Gates Foundation, Industry and product development agencies. Of the funded projects, 31 have included collaborations within the Consortium, 30 included partners external to the Consortium, and 47 (>70 %) have involved industrial partners. The funded themes included: 21 vaccines development projects (including an evaluation of a Zika virus fowlpox-based vaccine); 18 drug/biologics discovery projects; 16 diagnostic discovery/development projects (including AMR); 7 new insecticide resistance, surveillance and control tools; 3 anti-venom therapies; 2 adjunct therapy projects and 1 intervention (bed nets).

Education

As one of the few postgraduate centres of excellence in the field of tropical medicine and global health, LSTM offers unrivalled learning opportunities to students not only within the UK but also across the developing world. New initiatives such as a blended learning approach to our Masters in Global Health, investments into virtual learning environments and growing partnerships with NGOs and other research institutions all offer our students the opportunity to excel.



Professor Phil Padfield -
Dean of Education

Throughout the past academic year, the Department of Education focused on further improving the student experience and their welfare; the operational efficiency of the department which includes improving cost effectiveness and expanding the student numbers (see page Students & Courses).

Review of existing Taught Programmes

Much of 2018/19 has been taken up with a review of LSTM's existing portfolio postgraduate taught programmes. This has involved a series of workshops where programme and module structures and academic content were examined, and assessment portfolios evaluated. The outcome of this work is that LSTM will be adopting a simplified programme structure with fewer larger taught modules and a smaller number of summative assessments. In addition, generic employability skills and core discipline specific competencies were identified and will be embedded in the revised programmes through a process of curriculum mapping. The simplified programme structures will create space in the teaching timetables for extra-curricular activities that support student wellbeing and resilience. The proposed changes will provide students with a better educational experience and improved learning environment.

Postgraduate Taught Experience Survey (PTES) results

PTES is a national survey for Masters, PGCert and PGDip students. It runs every year and is used to gather information about the learning experience of taught postgraduate students. The PTES focuses on students' experiences regarding teaching and learning, engagement, assessment and feedback, organisation and management, resources and services and skills development. It enables comparison with other institutions and the wider sector, as well as year-on-year benchmarking of scores at LSTM.

LSTM's 2018/19 PTES scores were higher than those recorded for 2017/2018. Of particular note LSTM was placed 4th out of the 84 participating institutions for skills development with a score of 88% (with a 7% increase over 2017/18) and 5th for teaching quality with a score of 89% (7% increase over 2017/18).

The biggest rise was seen in overall student satisfaction, which rose 15% to 90%, placing LSTM 7th.

Launch of Student Advice and Wellbeing (SAW) service

As part of enhancing the LSTM student experience, the Student Advice and Wellbeing Service was set up in April 2019 to ensure that students studying both at LSTM and who are based overseas receive comprehensive, professional and timely support.

The key objectives of the Student Advice and Wellbeing Service are:

- To ensure that all students, irrespective of where they are based, receive professional and responsive Student Advice and Wellbeing support throughout their duration of study.
- To enhance the student experience and journey by ensuring that students feel valued and integrated into the LSTM community.

The SAW team provides a wide range of support mechanisms including:

- Accommodation advice and guidance.
- Big White Wall, an online mental health platform, accessible 24 hours a day/ 7 days a week with a valid LSTM email address.
- Support for students with disabilities through Individual Learner Plans (ILP's)
- Financial support via the LSTM Hardship Fund and access to other forms of financial support for International students.
- Provision of support for students who are experiencing



DTMH students, class of spring 2019,
with course director Dr Angela Obasi

psychological distress and mental health conditions through a range of mediums including face to face support, online self-help material, eBooks, psycho-educational workshops and personal development groupwork sessions.

- Support to students who pose safeguarding concerns.
- A range of activities aimed to enhance to student experience such as the Walking for Health Scheme, Meet the PhD event, craft sessions and fitness sessions.
- An Exercise Referral Scheme.
- Opportunities to become a LSTM Student Representative and to convey their own, and other students, experiences and raise concerns through focus groups, forums and surveys.

Leadership Education Academic Partnership (LEAP) Programme

In partnership with the international medical charity Médecins Sans Frontières (MSF) and Humanitarian & Conflict Response Institute (HCRI) of the University of Manchester, LSTM welcomed its inaugural cohort of LEAP students in February 2019.

The Leadership Education Academic Partnership integrates world-class higher education into the career paths of humanitarians, with the intention of strengthening leadership within the sector. As part of the launch, students also participated in a launch event held in March 2019 in Liverpool with senior leadership of all 3 organisations participating in a panel discussion focused on the topic of 'The humanitarian professional at a crossroads: combining experience and knowledge in humanitarian practice.'



LSTM Director, Professor David Lalloo, opening the LEAP launch event

This partnership provides an opportunity to showcase our offering to the wider Non-Governmental Organisation market and strengthens our footprint and impact in the global humanitarian context.

Developing the next generation of UK Global Health Leaders, OfS Catalyst Bid

LSTM completed the first year of reporting on its project for 'Developing the Next Generation of UK Global Health Leaders' as part of wider 3-year initiative that has attracted £1.02m of Office for Students (OfS, formerly HEFCE) funding to support this initiative.

The project strengthens LSTM as the UK's 'go to' institution for training and development of global health professionals and leaders.

Active Learning Laboratory

A key feature in LSTM's education expansion plan is the multi-functional Active Learning Laboratory (ALL), funded by charitable donations including the Garfield Weston Foundation. Its flexible layout and interactive AV facilities offer a dynamic environment which can be used for both formal teaching sessions and informal social study, providing a much-needed boost to the independent study facilities already provided by the library.

The ALL encourages the growth of teaching practices which support students to work collaboratively and actively participate in the learning process.

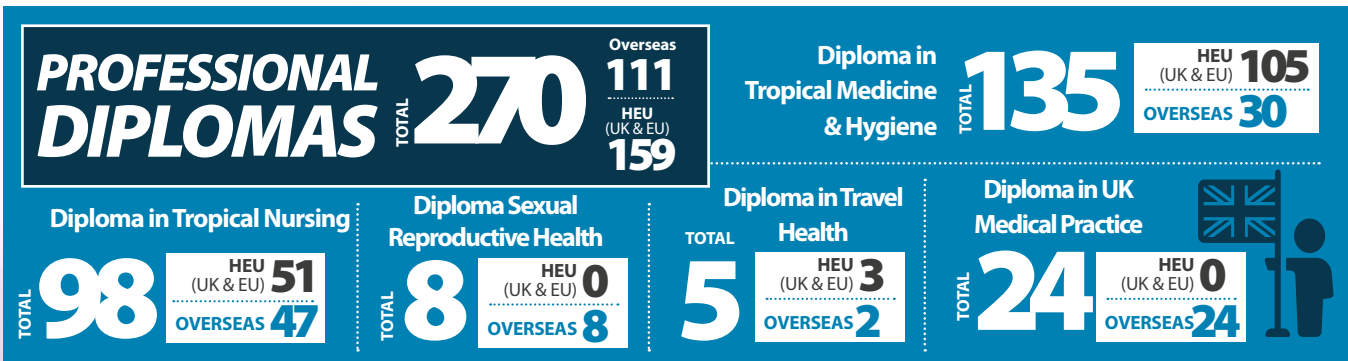
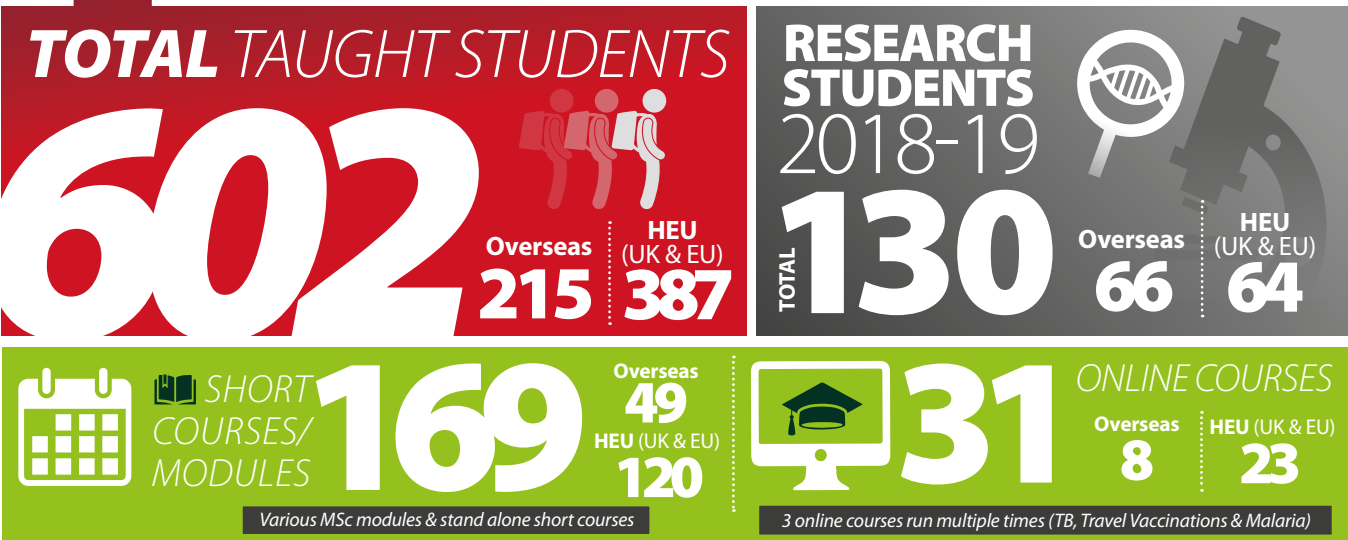
Its value has been recognised as the ALL has been shortlisted for multiple awards, including the Technological or Digital Innovation of the Year category of the Times Higher Education Awards; the Education Project of the year by the European AV industry awards and the Digital and Technology category of the Liverpool Chamber of Commerce Annual Awards.

Graduation

LSTM held its first independent graduation ceremony at Liverpool's iconic Liver Building on Thursday 6th December 2018, after having received its degree awarding powers the year before. The two ceremonies accounted for the graduation of 352 students and saw 85 graduates taking to the stage to be awarded their Masters, PhDs and diplomas.



Students and Courses



PROFESSIONAL CERTIFICATES



Clinical Diagnostic Parasitology Laboratory (CDPL)

CDPL offers a referral service for the identification of a wide range of human parasites from clinical specimens. This year the team in CDPL examined around 4,000 clinical samples, referred to CDPL from NHS trusts and UK private clinics as well as those throughout Europe. The laboratory provides diagnostic testing for a range of human parasitic infections including those that LSTM specialises in such as malaria, filariasis, schistosomiasis, strongyloides and African trypanosomiasis.



Jayne Jones - Manager of CDPL

In November 2018, the laboratory's UKAS accreditation to ISO 15189:2012 International standard was maintained for all tests placed on scope of practice. This accreditation demonstrates the quality service provided by CDPL to service users around the UK and globally. Service users are assured that they are receiving a quality service, provided by professional staff who are using the tests appropriate to their user demographic.

CDPL is enrolled in four national external quality assurance schemes for faecal parasitology, blood parasitology, parasite serology and malaria rapid. A variety of samples are sent throughout the year for diagnosis and CDPL continues to gain high marks for these four schemes.

CDPL continues to integrate with LSTM's diagnostic research team led by Dr Emily Adams. This provides the mechanism for validation and verification of molecular tests that will enhance the portfolio of the diagnostic testing performed within CDPL. This link also strengthens the bonds between clinical work and research being performed within LSTM. The link with LSTM's diagnostic research team has allowed the extensive evaluation, validation and verification of a faecal gastro-intestinal PCR panel that will be offered as a diagnostic test. This is an exciting time for the unit as the test detects not only selected protozoa but also selected helminths within one multiplexed Polymerase Chain reaction (PCR), a diagnostic test used to amplify and detect parasite DNA.

The laboratory continues to work with the Ministry of Defence (MOD) as it is contracted to perform diagnostic work for another 3 to 5-year period within certain MOD personnel groups.

CDPL has been selected to be a reference laboratory for a global funded study called "Febrile Illness Evaluation in a Broad Range of Endemicities (FIEBRE)" funded by the UK Department for International Development (DFID). The FIEBRE study will

be carried out at five sites in Africa (Malawi, Mozambique, Zimbabwe) and Asia (Laos, Myanmar) and will focus on detecting infections that are treatable and/or preventable. CDPL will receive samples from the FIEBRE study for external quality control (EQC) of microscopic diagnosis of malaria and other blood parasites from a sample of blood films prepared and read at each study site.

The laboratory's Quality Management System (QMS) is also being streamlined. The laboratory manager is working with LSTM's IT department to see development of systems that can be utilised on a tablet whilst staff are working around the laboratory suite.



CDPL's Iain Slack preparing a biological sample for parasite microscopy

Well Travelled Clinics



Well Travelled Clinics (WTC) has continued to trade strongly with the two branches in Liverpool and Chester seeing over eleven thousand patients and turnover increasing to £1.1 million delivering a profit of £76K.



Philippa Tubb - WTC Managing Director

Specialist travel-related Occupational Health (OH) services continue to provide a significant contribution to our strong business performance, not only in relation to the specialist medical services we provide, but OH also contributes to WTC's income in terms of additional vaccine and malaria tablet sales. WTC has maintained all its existing corporate contracts and has also added new clients to its business portfolio.

The Chester clinic was inspected by the Care Quality Commission in November 2018 and received an extremely positive report from the inspectors stating that the service was safe, effective, caring, responsive and well-led. The inspectors received 30 comments cards from patients during the inspection visit who stated that the clinic provided an excellent service and that staff were very informative and helpful.



WTC nurses outside the Liverpool clinic

Together with LSTM, WTC launched a new online Professional Diploma in Travel Health in May 2019, with 5 students in the first cohort. The next cohort started in September 2019

with 12 students. The online Diploma has been developed in conjunction with the National Travel Health Network and Centre (NaTHNaC) and is providing training to Doctors, Nurses, Pharmacists and other travel health professionals who wish to further develop their clinical practice in travel medicine.

A student from the first cohort said:

"The Diploma in Travel Health has proven to be a unique, well structured and engaging course. I find it to be an effective tool for building core skills and knowledge in travel medicine. The activities in the course support active assimilation of the material and processes into practice, leading to immediate and ongoing quality improvement". (Paediatrician from the USA).

Well Travelled Clinics continues to offer placements to undergraduate nursing and medical students and also offers training opportunities to qualified doctors and nurses who wish to further develop their knowledge, skills and practice in Travel health. This year there were five medical students on placement from Manchester Deanery, and WTC was presented with a Quality Teaching Practice Gold Award for excellence in teaching for the Year 4 - Quality & Evidence Personal Excellence Pathway (QEPEP) student placements.

2018/19 AT A GLANCE

THIS YEAR, WELL TRAVELLED CLINICS:

Answered
54,776
phonecalls

Gave
12,257
vaccines

Dispensed
50,606
malaria tablets

Saw
11,182
patients

Sold **2247** bottles of DEET insect repellent

Carried out **31** sickness and absence medicals for corporate clients

Carried out **133** sea-farer medicals for maritime workers

Carried out **232** pre-deployment medical screenings for overseas workers

Carried out **98** oil & gas medicals for offshore workers

Liverpool Insect Testing Establishment (LITE)



Liverpool Insect Testing Establishment (LITE) provides a professional testing service to commercial partners to accelerate the development of new public health insecticides and vector control tools.



Helen Williams - Head of LITE

Established by the Department of Vector Biology eight years ago, and with IVCC funding, LITE employs a team of research technicians, study directors, research assistants and quality assurance specialists.

Housed in state-of-the-art and purpose-built facilities in the Liverpool Life Sciences Accelerator Building LITE maintains a wide range of fully characterised mosquito strains, selected to incorporate the key resistance mechanisms circulating in field populations, maintained under stringent conditions to ensure consistency between tests.

During 2019 LITE published two important papers to help clients select the most appropriate mosquito strain and test assay. The first describes the testing pipeline we have employed for evaluating agricultural insecticides to assess their suitability for use in future mosquito control products. The second describes the properties of the resistant strains we maintain in LITE, describing their resistance phenotypes and the underpinning resistance mechanisms. Both publications are available on the LITE website.

Throughout the past 12 months LITE has been undertaking an increasing number of studies to understand the entomological mode of action of newer vector control products and insecticides. This has included studies on factors affecting mosquito's ability to feed on Attractive Targeted Sugar Baits (ATSB) and studies on how the physical properties of insecticides on a surface affects their biological activity. LITE is also contributing to the World Health Organization's multi-site study to define 'diagnostic doses' for new insecticide classes used in public health.



LITE insectary supervisor Dr Laura Valerio blood feeding cages of Anopheles mosquitoes using a Hemotek artificial membrane feeder

Insecticide Treated Nets (ITNs)

Insecticide Treated Nets (ITNs) are the mainstay of malaria prevention in Africa - where this parasite still causes over 400,000 deaths each year - and have been directly attributed to preventing approximately 500 million malaria cases in the first 15 years of this century. Until 2017, all ITNs were manufactured with pyrethroid insecticides only. LSTM's research on the causes, consequences and rapid spread of pyrethroid resistance, and advocacy to highlight the public health threat of resistance, has led to the development and deployment of new classes of ITNs, with superior activity in controlling pyrethroid resistant mosquitoes. Many African countries are now deploying these 'next generation' nets in their national net distribution schemes. LSTM has several active projects to evaluate the impact of these new nets on malaria transmission.



IVCC



IVCC's mission is to create and deliver a toolbox of disruptive vector control innovations for malaria eradication. The toolbox includes established product classes such as long-lasting insecticide treated bed nets (LLINs) and Indoor Residual Sprays (IRS), as well as new product classes such as Attractive Targeted Sugar Baits (ATSBs). Although primarily focused on malaria, IVCC is capitalising on its knowledge and malaria innovations to address neglected tropical diseases (NTDs) such as dengue.



Dr Nick Hamon - CEO of IVCC

To guarantee the timely delivery and impact of these interventions IVCC has to address a wide range of risks and barriers to successful product development. These include ensuring appropriate insecticide resistance management (IRM) and integrated vector management (IVM) strategies are implemented to minimise resistance and optimise performance. Building and supporting laboratory and field capabilities, keeping innovators engaged, driving delivery, access and market shaping interventions to ensure procurement and impact at scale.

Next Generation Indoor Residual Spray (NgenIRS)

2018/2019 has been a key year for IVCC. Three major initiatives are coming to the end of their funding cycle and several new initiatives are just beginning. The Unitaid funded NgenIRS project, which is in its fourth and final year, has protected 119 million people since 2016 using 3rd generation IRS (3GIRS). Where 3GIRS has been used, a 20 – 47% drop in malaria incidence has been reported in countries where impact evidence has been collected, and it is estimated that between 4.6 and 9.2 million malaria cases will have been averted with between 14,000 and 28,000 lives saved through NgenIRS supported IRS campaigns.

Good Laboratory Practice (GLP) certification

In 2014, IVCC and its funding partners started an initiative to ensure GLP certification across seven field testing sites in Africa. Today, three sites are fully GLP certified and the four remaining sites are expected to be GLP certified by the middle of 2020.

Zika Grand Challenge programme

The USAID-funded Zika Grand Challenge programme is also coming to a successful conclusion, with a selection of high potential projects moving forward with new funding and industry partners. IVCC, along with External Scientific Advisory Committee members, provided regulatory advice, risk assessments, economic modelling, as well as field testing for nine key vector control projects. Several of these Aedes mosquito initiatives will be tested in the new IVCC Indo-Pacific Initiative (IPI), supported by the Australian government along with additional support from DFID.

Brand new insecticide

In September 2019, IVCC promoted a brand-new insecticide from Mitsui into full development. The first product on the market will be an IRS with a novel mode of action, hopefully followed by a dual active ingredient LLIN.

New Nets Project

With the support of Unitaid and the Global Fund, The New Nets Project is moving towards the end of its first year, culminating with the deployment of over three million next generation insecticide treated bed nets in 2019 and up to thirty million more over the next four years.

'Zero by 40'

In January, Bill Gates hosted IVCC's second 'Zero by 40' meeting with the CEOs of the major crop protection companies active in public health innovation at the World Economic Forum at Davos. In 2018, these companies signed a declaration for vector control that comprised of 11 key objectives, including a commitment to 'stay the course' on new vector control product development and to work collaboratively on selected potentially game changing intervention classes.

In 2019, IVCC welcomed one new funding partner, the Global Fund, twelve new members of staff, several new Board of Trustees and a new Board Chairman, Sir Stephen O'Brien, replacing Sir Mark Moody-Stuart. IVCC ensure its strategy and 'Zero by 40' initiative were aligned with the Bill & Melinda Gates Foundation's six is aligned with the Bill & Melinda Gates foundation's six pivot malaria eradication strategy and the expectations of other funding partners. It is reassuring to see that the IVCC strategy is also closely aligned to the newly published Lancet Commission on Malaria Eradication, which calls for substantial investment in new diagnostics, drugs, and vector control technologies and is supporting the drive for eradication by 2050 with smarter use of current tools, a broader roll-out of available tools and the development and deployment of new tools.

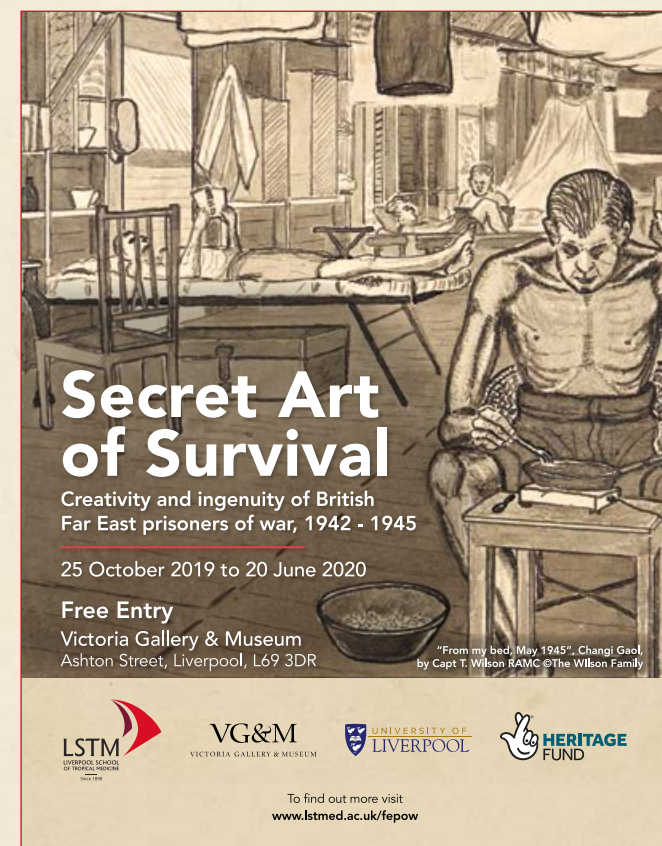


Zero by 40 participants, from left to right: Liam Condon, CEO Bayer; Hans-Ulrich, Vice Chairman of the Board of Executive Directors and Chief Financial Officer, BASF SE; Nick Hamon CEO, IVCC; Erik Fyrwald, CEO Syngenta; Bill Gates, Co-chair The Bill & Melinda Gates Foundation; Kazunori Tani, Executive adviser of Mitsui Chemicals Agro, Inc; Ray Nishimoto, Representative Director & Senior Managing Executive Officer, President of Health and Crop Sciences Sector, Sumitomo Chemical Co., Ltd.; Gaoning (Frank) Ning, Chairman at Sinochem Group and Rodger Voorhies, President of the Global Growth & Opportunity Division of the Bill & Melinda Gates Foundation.

Far East prisoners of war (FEPOW)

LSTM's involvement with ex-Far East prisoners of war (FEPOWs) is the longest collaboration in its history. It began in 1945 when Professor Brian Maegraith instituted the medical care of desperately sick returned Far East POWs. Many of them had recurrences of malaria, dysentery, as well as psychiatric problems - later recognised as post-traumatic stress disorder (PTSD). Other medical problems included hepatitis B - related liver disease, nutritional neuropathies, and chronic infections with the nematode worm *Strongyloides stercoralis*. Over 4,000 ex-FEPOWs were seen at LSTM and the collected clinical and research data resulted in over 12 peer-reviewed papers in medical literature.

With declining POW referrals, the last two decades focused on the medical history aspects of the FEPOW story, led by Professor Geoff Gill and Meg Parkes. Most recently they have been investigating POW art in captivity and this has resulted in both a new art exhibition in Liverpool and the publication of a third book.



Exhibition

Previous LSTM/FEPOW medical history studies revealed unseen, secretly-produced artwork from captivity. Some of the artists were relatively well known – for example Ronald Searle, Jack Chalker and Leo Rawlings – but many were not. This newly-discovered art documents camp life, individuals, disease and medicine, the environment and local flora and fauna, all painted or drawn at great risk to the artist as it was strictly forbidden by the Japanese.

In collaboration with the University of Liverpool's Victoria Gallery and Museum (VG&M) and supported by the Heritage Lottery Fund (HLF), a successful Crowdfunding appeal and FEPOW descendants' associations, LSTM opened a major exhibition of FEPOW art in October 2019 which will run until June 2020. Three quarters of the items displayed come from private lenders, much of it not been seen in public before.

Special guest, Philip Mould OBE, international art dealer, writer and broadcaster officially opened the exhibition. Over 100 items are on display, including paintings, sketches, carvings, engravings and secret photographs.

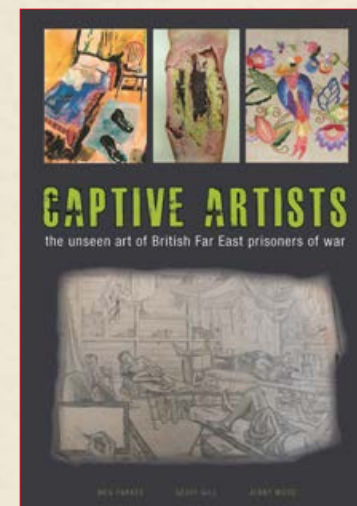
This is the first time that so much previously unrecognised FEPOW art, produced under great adversity, has been brought together. It is complimented with a programme of public lectures, talks, school outreach programmes and study days for the families of Far East POWs.

For more details see www.captivememories.org.uk

Captive Artists

This new book, *Captive Artists - the unseen artwork of British Far East prisoners of war* - published in late 2019, is a companion volume to *Captive Memories* (2015) and *Burma Railway Medicine* (2017), both co-authored by Geoff and Meg and based on their respective academic studies. *Captive Artists* documents the seven-year FEPOW art investigation. Meg Parkes and Geoff Gill collaborated with Jenny Wood, former senior art curator at the Imperial War Museums, who contributed a wealth of knowledge and expertise in the field of British war art.

In full colour, *Captive Artists* has over 300 illustrations many of which are not in the exhibition and previously unseen. It can be purchased from LSTM's library with all profits to Far East POW funds at LSTM.



LSTM in the media

Over the past academic year LSTM shared 110 news stories on its research and interventions while its experts were regularly asked by media to provide context to some of the big questions in global health, locally and internationally. This resulted in more than 5,200 direct mentions in the online, broadcast and print media with potential audiences reaching the hundreds of millions.

LSTM's Centre for Snakebite Research and Interventions (CSRI), have been attracting significant media attention. The publication of WHO's strategy – Snakebite envenoming: a strategy for prevention and control, the announcements of an £80M fund for snakebite research by Wellcome and LSTM joining forces with IAVI as part of an international consortium which was awarded £9M from DFID, all came within a week. Resulting media requests included The Guardian, BBC Radio 5 Live, The Daily Mail as well as Reuters, CNN Indonesia, ITV News and the BBC World Service bringing the stories to over 300 million in potential audience figures, reflecting CSRI's global position as one of the key centres of snakebite research.



ITV science correspondent Tom Clarke at a venom extraction with CSRI's Professor Rob Harrison and senior research technician Paul Rowley

CSRI featured in a series of programmes from BBC World Service around Snakebite Awareness Day on 19 September. Global Health correspondent Tulip Mazumdar travelled to Kenya to look at the production of antivenom and interventions. This resulted in numerous radio-, TV- and online BBC World productions. CSRI also featured on the BBC Victoria Derbyshire Show demonstrating the effect of snake venom on her blood, which was repeated later on BBC World News. CSRI were also the main component for a new strand on China Television Global Network Europe, Razor.



LSTM's Centre for Neglected Tropical Diseases (CNTD) was subject of a large feature in the Daily Telegraph as Malawi handed documents to the WHO in order to be declared free of lymphatic filariasis. CNTD has been carrying out mass drug administrations in partnership with in country leaders to eliminate the debilitating disease. This was followed by some extensive media coverage on the visit of parliamentary under secretary of state, Baroness Sugg, to LSTM on the occasion of the launch of the 'Accelerating the Sustainable Control and Elimination of Neglected Tropical Diseases' (ASCEND) Programme, in which LSTM is a major partner.

Following her scientific review about the safe use of menstrual cups in the Lancet Public Health, LSTM's Professor Penelope Phillips-Howard was extensively interviewed about the issue, including BBC News, New York Times, The Independent and Cosmopolitan. This also included news stories on the environmental benefits of the use of menstrual cups as it can significantly reduce hygiene waste.

Academics from the Department of Vector Biology commented on issues ranging from antimalarial drugs; GM mosquitoes; dengue outbreaks, malaria vaccines. LSTM staff also featured in a Newsnight broadcast on the impact of Brexit on the LSTM workforce.

Dr Adam Roberts' AMR research was also featured in a BBC1 documentary on the risk of AMR where he explained to presenter Angela Rippon his 'Swab & Send' project, which hopes to discover new antibiotics through engaging with the public to send him swabs from unusual environments.

Two years ago, LSTM initiated the so-called 'SciFri' (Science Friday) slot on BBC Radio Merseyside. Multiple LSTM staff members were interviewed throughout the year on their specific area of expertise and what motivates them, leading to regular enthusiastic feedback of listeners.



LSTM Alumni and Friends

We are proud to have such a rich and diverse community of alumni and friends from over 90 countries, having a huge impact in the field of global health. They are some of the most powerful advocates we have, and we are working to revitalise our relationship with them to create a vibrant and engaged community of alumni and friends.

Alumni engagement

We aim to keep our network of alumni and friends fully engaged with LSTM through a programme of communications, tailored events, and collaborations.

In July 2019, we published our redesigned eTropical newsletter. It keeps alumni, staff and stakeholders up-to-date with all the latest news, events and career opportunities at LSTM.

December 2018 saw the launch of LSTM's very first graduate publication: Lead. It was published just in time for LSTM's first graduation ceremony. Celebrating the success of our alumni and sharing great stories, past and present, Lead aims to showcase the very best of LSTM.

Our efforts to reconnect with lost alumni and friends received a fantastic response with almost 2,000 individuals now signed-up. However, the responses were heavily based in the UK, North America and Australia. We know that we have many more alumni and friends out there and we understand we need to explore a number of initiatives work, in collaboration with key partners, employers, staff and students, to reconnect with especially those living and working in Africa and Asia.

Inaugural alumni event

LSTM held its first alumni and friends reception in September 2019, as global health leaders from around the world gathered in Liverpool for the 11th European Congress on Tropical Medicine and International Health (ECTMIH).

The reception, held within the unique setting of the Museum of Liverpool on Liverpool's historic waterfront, provided guests the opportunity to meet and network with fellow alumni, LSTM colleagues and friends.

LSTM Director, Professor David Laloo, opened the event by welcoming guests and talking about the organisation's pioneering work and ground-breaking plans for the future, including the recently launched Health Innovation in a Virtual Environment (HiVE).

Alumni and friends survey

Building on our previous work, LSTM conducted an email survey with our alumni and friends to get their views on what they would like from an alumni and friends community.

Over 2,000 of them took part. The results from this survey will help to shape our future activity and we will work hard to ensure that we deliver an alumni programme that meets their needs.



LSTM alumni in conversation with LSTM Director, Professor David Laloo

Fundraising



For decades, LSTM has worked with partners to deliver ambitious and pioneering solutions to major health challenges. Some of these partnerships have included donors and philanthropists; supporting the development and realisation of a shared vision for impact and providing vital investments to support its delivery. Over the last year we have raised more than £2.6m in philanthropic contributions and have launched several new initiatives.



Scholarships to attract future global health leaders

With donors' support we have been able to launch new scholarships. A major gift helped us to recruit the first cohort on the MSc Global Health blended learning programme.

The Harriette Kelso Scholarship is a full scholarship for the DTM&H programme and supports students from Sierra Leone. We are also grateful to the Oglesby Charitable Trust for three full scholarships for the Diploma in Sexual and Reproductive Health programme.

A generous donation from Professor Emerita Sonia Buist enabled a Pathway to Leadership Award for PATS MECOR graduates working in the area of pulmonary and critical care medicine in Africa.

Malawi Health Goals

The Malawi Health Goals project, established in 2017, uses football as a tool to convene and educate. The LFC Foundation and LSTM trained 25 local community coaches who led activities for more than 600 young people, with a week-long programme of activities culminating in the MLW Kafukufuku Festival in Chikwawa. In total, over 1,000 HIV self-test kits were distributed to participants and amongst the 5,000-strong crowd.

CREATOR

We aim to raise £2.5m in support of CREATOR (Centre for Research Excellence and Training Open Resource), a new development at the Malawi-Liverpool-Wellcome Trust Clinical research Programme in Blantyre.

Malawi has just 350 doctors for a population of 18 million.

There is one medical school for the whole country but no post-graduate training. This represents a critical issue as the most qualified leave the health system at a point when their skills and experience are needed the most.

CREATOR will be a purpose-built centre, which will enable MLW to increase research capacity by 30% over the next ten years and will provide the first specialist postgraduate clinical training facility in the country.

HIVE

HiVE (Health Innovation in a Virtual Environment) is a virtual incubator, which aims to identify and test new ideas for global health by matching HiVE 'Pioneers' with brilliant, but undeveloped, ideas with mentors and experts drawn from a multidisciplinary HiVE community. Virtual collaboration is complemented by a HiVE key skills curriculum, building the foundation for future independence and success.

HiVE is currently in a pilot phase with 20 participants in Ghana identified and in the process of being matched.

Our funding model includes a combination of philanthropic and grant support to enable us to run and refine the programme, with the development of a profit-share social impact investment plus fee-based consultancy for non-LMIC partners in the future.



Malaria in pregnancy

Malaria in pregnancy is one of the leading causes of adverse pregnancy outcomes. Current control strategies are under threat due to increasing drug resistance and suboptimal coverage with existing

tools. LSTM has been the coordinating centre of the Malaria in Pregnancy Consortium, a network of 40 research institutions, that aimed to improve the control of malaria in pregnancy. LSTM led research, consisting of meta-analyses, observational studies and multicentre trials, has directly contributed to WHO and endemic country policies on the treatment and prevention of malaria in pregnancy in different transmission and drug resistance strata in sub-Saharan Africa and Asia-Pacific.



Estates

Throughout the last academic year, Estates, in collaboration with research groups, education and other professional service teams, has supported all manner of activities, both in the UK and overseas, ranging from travel safety and security, to multimillion-pound capital projects.

Safety and laboratory management

The safety and laboratory management team provided support across all LSTM activities, minimizing potential risks and safeguarding LSTM's reputation. In addition to providing pragmatic advice the team monitored the effectiveness of policy and process by undertaking a programme of monitoring inspections and audits including the MLW campus in Malawi.

The structure of the Health, Safety and Environment Committee is being reviewed to fit with the new committee structure thus ensuring an effective risk-based approach to all LSTM activities. Work with biological agents (pathogens and GMOs) will continue to be overseen by the Biological Safety Committee. The Travel Team, working closely with the Travel Overseas Working Group Travel and with support from specialist service providers, continues to oversee and monitor the risks associated with staff, student, consultant and volunteers travelling overseas on business.

Environmental management

LSTM, being fully committed to operating in an environmentally friendly and sustainable manner, has introduced a new Environmental Policy and established an Environmental Working Group. It will provide coordination and guidance to LSTM for the integration of sustainability principles and practices throughout core teaching, research and operational activities.

Capital works

All refurbishment projects incorporate environmental and/or energy improvements whenever practicable, such as replacement windows, improved roof insulation, LED lighting, improved BMS controls etc. The benefits of which can now be seen when reviewing the independently assessed Display Energy Certificate ratings for the past three years.

To provide visibility of future maintenance commitments an independent quinquennial condition survey has been undertaken of all the building stock in Liverpool. The survey data, a schedule of the maintenance required for each building element, prioritised, with a budgeted cost and priority will be used as the basis for the Planned Maintenance Programme for the next five years.

In parallel with the condition survey, a functional suitability review was undertaken to determine and measures the

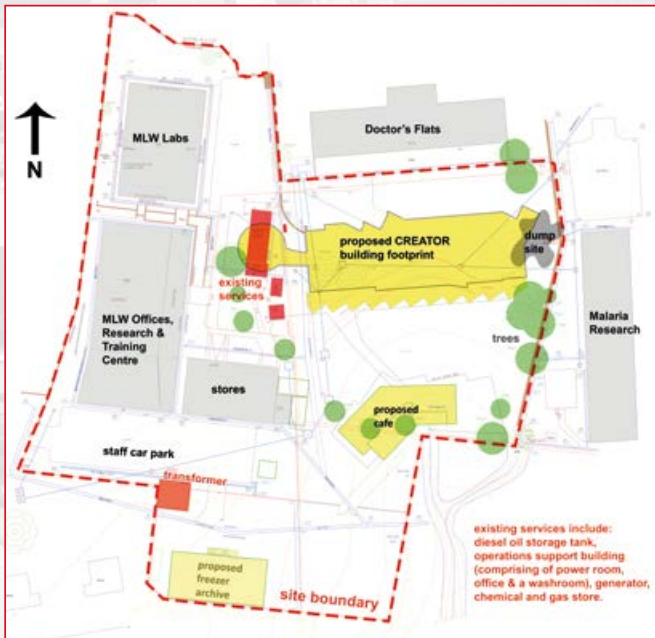
capability of the space, to support its existing function. The functional suitability review has several elements, including: legislative compliance, energy performance, environment, layout, location, flexibility, servicing, user perception and external environment.

New service desk

To assist the maintenance, facilities and reception teams in further improving the customer experience and expand the ability to provide management information in terms of performance, the "Estates Maintenance Helpdesk" has been replaced by the online "Estates Service Desk". Phase 2 of the implementation will include modules for property management, planned preventative maintenance, asset management and room booking.

Malawi

The Clinical Research Excellence and Training Open Resource (CREATOR) building project is currently at RIBA Stage 3+. Detailed site investigations were undertaken by the consulting engineers with support from MLW facilities management. The purpose of the site surveys and inspections was to collect data to inform the design and mitigate risks. Governance for the project is provided by the CREATOR Building Steering Group, with representatives from LSTM, University of Liverpool and MLW.



People and Culture

LSTM continues to grow: in the last year the staffing level increased by almost 10% from 532 to 582. This is supported through the strategy of strengthening our human resourcing capability. The key is to attract and retain the most talented people and make LSTM a great place to work.



Samantha Airey - Global Director of Human Resources

Culture and engagement

LSTM is committed to become an employer of choice and a place where colleagues can thrive. Over the past year a number of townhall meetings have been organised to discuss and hear views of colleagues. In response to feedback previously received, the use fixed term contracts has been reviewed and an exercise to transition people to permanent contracts undertaken.

These engagement activities will continue as LSTM aims to improve and extend ways to ensure it is listening and taking account of the views of all colleagues and stakeholders.

Career progression

It is an LSTM priority to extend opportunities for career development and progression. Over the past academic year Rachel Tolhurst (International Public Health), Peter Macpherson and Jamie Rylance (Clinical Sciences); Adam Roberts and Joe Turner (Tropical Disease Biology) were promoted to Reader. Henry Mwandumba, Penny Phillips Howard, Nick Casewell, Nick Feasey and Miriam Taegtmeier were offered were offered personal Chairs.

LSTM's successful career track programme supports academic leaders of the future. In 2018-2019, Dr Charles Ameh successfully completed the programme. The three current candidates were joined by a further five in September 2019.

LSTM recognises the need to make strategic appointments at early career level and has embarked on a campaign to attract and appoint to key lecturer posts across the institution. It plans to adopt the Concordat to Support the Career Development of Researchers and a working group has been established involving colleagues to consider the newly published Concordat edition and identity priorities to create the conditions for researchers to flourish. As LSTM supports career paths and development for colleagues in all areas, a newly created Learning & Development Manager post has been appointed.

Diversity and equality

LSTM is committed to equality and diversity and recognise there is great scope to develop the organisational response to challenges of underrepresentation and progression as well as foster a greater culture of inclusivity. The most recent gender pay gap report highlighted the gender imbalance at a senior level.

LSTM reviewed its equality and diversity programme and developed a framework to help build and broaden future activity based on targets and reporting, embedding E&D into key people management policies including recruitment, development and management, fostering an inclusive culture and establishment of networks.

Working towards the Athena Swan silver award, LSTM has included the launch of mentoring scheme and a parent buddy programme to support those returning to work from parental leave. A fund has been established, open to staff and students to support initiatives which are aligned to Athena Swan goals. It supported training and part sponsored the Equality in Science conference.

The impact of Brexit showed in a noticeable decline of EU applicants. LSTM continues to provide support and information and guidance to staff and students.

Safeguarding and Freedom to Speak Up

LSTM takes its responsibilities for safeguarding vulnerable adults and children very seriously. Under the direction of Philippa Tubb, LSTM's Safeguarding Officer, a Code of Conduct and staff training has been implemented. LSTM works with its partners to promote safeguarding.

Linked with this, the Freedom to Speak Up initiative was launched, which provides the opportunity for individuals within and within and outside LSTM to raise issues confidentially and anonymously relating to safeguarding, staff or student concerns.

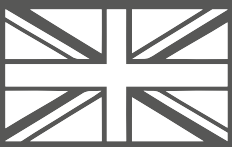
Human Resources (HR)

The HR function is undergoing a period of transformation as the way the department partners with the organisation and support colleagues is being reviewed. Following a restructure, new areas of responsibility relating to organisation development, learning and reward have been introduced. LSTM continues to develop its people management practices and services.

Staff Overview



539 staff members in the UK on a UK contract



43

staff members overseas on a UK contract



582

TOTAL STAFF



Numbers as per 1 September 2019 - excluding IVCC & WTC staff members

Structure, governance and management

In November 2018, the new code of conduct for Trustees was adopted by the Board. This sets out the commitment throughout LSTM to the professional and personal conduct of all Trustees.

Governance principals

LSTM endeavours to conduct its business in accordance with the seven principles identified by the Committee on Standards in Public Life: selflessness, integrity, objectivity, accountability, openness, honesty, and leadership; and within the general principles of the Higher Education Code of Governance which has been provided by the Committee of University Chairs.

Following application to the Office for Students (OfS) for approved provider registration, LSTM provided OfS with a renewed commitment in also upholding the following Public Interest Governance principles that apply to all approved registered providers:

- I. Academic freedom: Academic staff at LSTM have freedom within the law: to question and test received wisdom; and to put forward new ideas and controversial or unpopular opinions without placing themselves in jeopardy of losing their jobs or privileges they may have at the provider.
- II. Accountability: LSTM operates openly, honestly, accountably and with integrity and demonstrates the values appropriate to be recognised as an English higher education provider.
- III. Student engagement: The Board of Trustees ensures that all students have opportunities to engage with the governance of the provider, and that this allows for a range of perspectives to have influence.

- IV. Academic governance: The Board of Trustees receives and tests assurance that academic governance is adequate and effective through explicit protocols with the senate/academic board (or equivalent).
- V. Risk management: LSTM operates comprehensive corporate risk management and control arrangements (including for academic risk) to ensure the sustainability of the LSTM's operations, and its ability to continue to comply with all of its conditions of registration.
- VI. Value for money: The Board of Trustees ensures that there are adequate and effective arrangements in place to provide transparency about value for money for all students and (where a provider has access to the student support system or to grant funding) for taxpayers.
- VII. Freedom of speech: The Board of Trustees takes such steps as are reasonably practicable to ensure that freedom of speech within the law is secured within the provider.
- VIII. Governing body: The size, composition, diversity, skills mix, and terms of office of the Board of trustees is appropriate for the nature, scale and complexity of the provider.
- IX. Fit and proper: Members of the Board of Trustees, those with senior management responsibilities, and individuals exercising control or significant influence over the provider, are fit and proper persons.

Focus on Risk Management

These are uncertain times for both the Higher Education sector and the global economy. As LSTM's principal executive body, the Board of Trustees takes primary responsibility for ensuring LSTM has an effective and balanced risk management framework in place.

Accountability and responsibility for risk mitigation is assigned to management across the devolved organisation. Business risk-management is at the core of LSTM's overall system of internal controls and is designed to focus on and mitigate, to every extent possible, the most significant risk events that might adversely or beneficially affect our ability to achieve our policies, aims and objectives. Management are encouraged to implement good risk-management practice across LSTM.

LSTM follows good practice seeking to ensure an appropriate balance between risk aversion and opportunity capture. The business risk-management approach identifies and appraises risks and opportunities in a systematic manner and

is integrated and embedded within LSTM's planning, decision making and operational management processes.

LSTM makes conservative and prudent recognition and disclosure of the financial and non-financial implications of risks. The Risk Management Strategy is communicated throughout LSTM.

Audit Committee advises the Board of Trustees, overseeing operational risk management across LSTM and scrutinising the Risk Register, identifying and quantifying fundamental risks, and ensuring arrangements to manage those risks are put in place and their effectiveness reviewed through an annual programme.

Additionally, the Audit Committee receives an annual opinion from the internal auditors on the adequacy and effectiveness of LSTM's arrangements for risk management, control, governance and Value for Money and provides assurance to the Board of Trustees on the adequacy and effectiveness of LSTM's arrangements for risk management.

Board of trustees membership

An effective Board of Trustees has a good range of skills and qualities and a variety of professional and personal experiences which helps to ensure the board make well-rounded decisions. Board champions are now appointed in each area of Equality and Diversity, PREVENT duty, GDPR and Safeguarding. The ongoing Trustees skills audit and assessment exercise ensures that the Board operate effectively within its governance arrangements.

The transition of LSTM Director from Professor Janet Hemingway to Professor David Lalloo begun in the latter term of 2018 - ahead of the formal commencement date of 1st January 2019. Professor Lalloo's attendance at the Board of Trustees meeting in November 2018 as Director-Elect, allowed the formal handover of responsibilities to commence. Professor Lalloo brings a renewed determination to the role of LSTM Director and the Board were delighted to welcome him formally to its meeting.

LSTM welcomed Andy Wright to the Board of Trustees early in March 2019. He has twenty years' experience leading global health programmes. As Vice President of Global Health Programmes at GSK, he was responsible for leading the team implementing GSK's portfolio of donation and grant making programmes aimed at improving the health of underserved people in the developing world. These included the donation of albendazole for neglected tropical diseases, a partnership with Comic Relief to combat Malaria, a partnership with Save the Children improving the lives of children in Africa and Asia, training of health workers in 40 Least Developed Countries, partnerships to strengthen academic institutions, humanitarian response and programmes to improve access to medicines. Mr Wright retired from GSK in 2019.

During its Away Day in June 2019, the Board welcomed a further two new Trustees: Professor Nyovani Madise and Joanne Dodd. Professor Madise is known for her research on the social determinants of sexual and reproductive health and rights in low and middle-income countries and is currently Director of Research and Development Policy for the African Institute for Development Policy (AFIDEP), based in Malawi. Previously a Professor of Demography and Social Statistics at the University of Southampton, Dr Madise co-led the Population Health University Strategic Research Group and co-directed the Centre for Global Health, Population, Poverty, and Policy. She has also worked as a lecturer in Malawi and Kenya and has field experience in Africa, Asia, and Latin America.

Joanne Dodd is a Chartered Accountant providing financial advisory services to businesses across the North of England. Following graduation from Durham University, Joanne qualified as a Chartered Accountant with Grant Thornton before moving to the corporate finance department of Ernst & Young where she specialised in due diligence and independent financial reviews on behalf of banks, private equity houses and other large financial institutions in both the UK and Europe. Following a period working in industry, Joanne set up her own business, Crabtree Capital, in 2008 which provides retained financial advisory services, often in a non-executive director capacity, as well as specific assignments for companies across sectors. All three members joined LSTM's Board during a period of renewed commitment to recruit members that bring exceptional talent, diversity and gender equity.

The Board of Trustees said goodbye to Dr Jenny Amery OBE who stepped down following nearly four years' service. Dr Amery OBE is a public health physician by training and a Fellow of the UK Faculty of Public Health. Early in her career she lived and worked in Peru and elsewhere in Latin America for 9 years, focusing on the health of poor women and children, and community development.

Also stepping down is Nick Earlam, Executive Chairman of Plexus Cotton Ltd, who has had a longstanding relationship with LSTM since 1997, joining our Board of Trustees in 2013. Mr Earlam has brought his experience of global operations and leadership to LSTM as President of the International Cotton Association and Chairman of the Association of Cotton Merchants Europe. Amongst many positions held outside of the cotton industry, he held the Chair of Liverpool Associates for Tropical Health (LATH) and co-founder of the Liverpool-Shanghai partnership.

Finally, the Board announced the planned retirement of its Chairman, James Ross OBE, and treasurer and Vice Chairman, Jon Schofield. James Ross as Chairman provided expert guidance and leadership of the Board for over twelve years. Similarly, Jon Schofield, a leading figure within the North West business community and chartered accountant, provided twelve years of service to the Board and Finance committees. LSTM is progressing its search with renewed commitment to maintaining the balance, skills and professional expertise that previous Board members have brought to their roles.

LSTM thanks all departing board members for their years of dedicated service and commitment.

Co-opted committee members

The Board of Trustees recognises the contribution of our co-opted members to the working governance arrangement of LSTM's committee structure. These individuals bring independent expertise and provide outstanding contribution and support to the Board of Trustees in discharging its responsibilities. Particular thanks are given to Ms Karmen Bennett, Co-opted representative for IVCC, and to Ms Nicola Boulton who have both joined Audit Committee as co-opted representatives. The Board of Trustees also wishes to thank Martin Cooke, co-opted member for Finance Committee, who will step down during 2019 following many years' service to LSTM and IVCC.

Vice presidents

The Board of Trustees at LSTM wish to thank current and former Vice Presidents for their continued support, advice and enthusiastic representation. The Board of Trustees wish to extend their deep condolences to the family of Peter Sissons LLD, former newsreader and LSTM Vice President. Mr Sissons joined LSTM six years ago and was instrumental in moderating numerous debates, academic sessions as well as conferences. In 2017 he oversaw the LSTM book launch of 'Burma Railway Medicine' as he had a specific interest in LSTM's Far East prisoners of war (FEPOW) project.

Officers 2018/19

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Sir Richard Evans CBE

CHAIRMAN
James Ross OBE

DIRECTOR
From January 2019
Professor David Lalloo MB BS MD FRCP FRCM RCPS (Glasg)
Stepped down December 2018
Professor Janet Hemingway CBE FRS DSc PhD BSc NAS (Foreign Associate) FMedSci FRCP (Hon) FRES (Hon) FAAM Hon FFPH

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Professor The Lord Alton of Liverpool KCSG KCMCO
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Dame Lorna Muirhead DBE
Dame Jane Newell DBE JP
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Michael Oglesby CBE
Sir Michael Perry GBE *Retired January 2019*
Dr John E Roberts CBE
Peter Sissons LLD *Passed away October 2019*
Dr James Smith CBE
Sir Crispin Tickell GCMG KCVO
Sir Mark Walport FRS FMedSci
Professor Sir David Weatherall DL MD FRCP FRCPE FRS
Passed away December 2018
Sir Leslie Young CBE LLD DL *Passed away October 2018*

BOARD OF TRUSTEES

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James Ross OBE

Hon Treasurer & Vice Chairman
Jonathan Schofield BA ACA

Trustees
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Dr Jenny Amery OBE *Stepped down November 2018*
Nick Earlam *Stepped down November 2018*
Professor Janet Hemingway CBE FRS DSc PhD BSc NAS (Foreign Associate) FMedSci FRCP (Hon) FRES (Hon) FAAM Hon FFPH *Stepped down December 2018*
Jeremy Lefroy MP
- Dr Julian Lob-Levyt CBE
Rebecca Nightingale MSc MRes BSc
John O'Brien B.Comm FCA
Sue Russell LLB (Hons)
Eileen Thornton CBE Med BA FCSP DipTP
Professor Stephen Ward BSc PhD
Andy Wright BSc MSc *Joined March 2019*
Professor David Lalloo MB BS MD FRCP FRCM RCPS (Glasg)
From January 2019

Secretary & Clerk to the Board of Trustees
Robert Einion Holland FCCA MBA

Awards and Honours

September 2019 - LSTM's Professors Hilary Ranson and Charles Wondji were recognised for their contributions to Capacity Strengthening in Africa by the Pan-African Mosquito Control Association (PAMCA) during their annual conference in Yaoundé, Cameroon.

September 2019 - LSTM PhD student Joseph Pryce and colleague Dr Tito Trésor Melachio from the Centre for Research in Infectious Diseases (CRID) in Yaoundé, Cameroon, were the first winners of the \$25,000 NTD Innovation Prize from the American Leprosy Missions, at the 10th NTD NGO Network Annual Conference in Liverpool.



PhD student Joseph Pryce (centre)

The prize was awarded for their project 'Exploring the viability of excreta sampling for monitoring Human African Trypanosomiasis (HAT).'

September 2019 - Hannah McCauley, Kirsty Lowe and Dr Mary McCauley, all of LSTM's Centre for Maternal and Newborn Health (CMNH) were shortlisted in two categories at the 2019 International Maternity Expo Awards. Hannah and Kirsty are jointly on the shortlist for the International Education Award and Mary is nominated for the Student and Trainee Award.

The awards are given to the 'very finest examples of maternity care, research and best practice'. The three are among the 46 nominees who have been shortlisted for 15 different award categories.

September 2019 - Former LSTM Director, Professor Janet Hemingway FRS, has been awarded the Sir Patrick Manson Medal, the Royal Society of Tropical Medicine and Hygiene's (RSTMH) highest mark of distinction.

Awarded tri-annually since 1923, Professor Hemingway FRS became the first woman to receive the medal. She did so as a joint recipient along with Oxford University's Emeritus Professor of Tropical Medicine, Dr David Warrell.

July 2019 - LSTM Professor Henry Mwandumba is awarded the Royal Society Africa Prize. The prize is given annually to recognise research scientists based in Africa who are making innovative contributions to the biological sciences, including basic medical science, which contributes significantly and to capacity building in Africa. Professor Mwandumba has been awarded the prize for his novel work in the description of the TB phagosome in HIV infected alveolar macrophages and his leadership in the College of Medicine in Malawi.



Professor Henry Mwandumba

March 2019 - LSTM alumnus Dr Waleed Al-Salem is one of the winners of the UK Alumni Awards 2019 in Saudi Arabia. Dr Waleed Alsalem won the Professional Achievement Award at a ceremony hosted by the British Council and British ambassador at the British embassy to Saudi Arabia. Dr Waleed Al-Salem's

Professional Achievement Award recognises alumni who have distinguished themselves through exemplary leadership in their professional field.



Dr Waleed Al-Salem

March 2019 - LSTM PhD student Karina Mondragon-Shem was one of the winners of the 2019 Young Scientist Seminar competition of iBiology. Karina studied the saliva of different blood-feeding arthropods that transmit diseases and obtained her PhD in May 2019.

March 2019 - British Society for Parasitology (BSP) awards its C.A. Wright Medal to LSTM Professor Russell Stothard. The Wright medal is presented annually since 1985 and recognises the outstanding contribution to the discipline of parasitology by a member of the BSP.

March 2019 - The Respiratory Research Team from LSTM's Accelerator Research Clinic (ARC) has won the Team of the Year category of the 2019 North West Coast Research and Innovation Awards. ARC is a partnership between LSTM and the Royal Liverpool and Broadgreen University Hospital NHS Trust.

February 2019 - Director of Partnerships and Business Development, Michael Lurie, was selected as one of the region's 2019 Export Champions by the UK Government's Department of Trade. In recognition for LSTM's contribution to the economic growth of the UK in general and England's north in particular, via export of educational programmes.

December 2018 - LSTM Dr Tim O'Dempsey received the Duncan Medal, together with nurse Pauline Cafferkey, for their outstanding work during the recent Ebola outbreak in West Africa, notably Sierra Leone. The Duncan Medal is issued by the Duncan Society, a Merseyside and Cheshire based organisation, which fosters discussion and debate about public health issues.

December 2018 - LSTM issued its first honorary degrees during its inaugural graduation ceremony. LSTM conferred its first honorary Doctor of Science Degrees to Alumna Dr Letitia Obeng from Ghana and Professor Victor Mwapasa from Malawi.



Professor Feiko ter Kuile (left)

November 2018 - LSTM Professor Feiko ter Kuile has been elected as an Honorary International Fellow of the American Society of Tropical Medicine and Hygiene (ASTMH). This special membership is conferred in recognition of outstanding accomplishments by an individual, who is not an American citizen, who has made eminent contributions to some phase of tropical medicine and hygiene.

October 2018 - LSTM's Hilary Simons was awarded Fellowship of the International Society of Travel Medicine - presented at the 16th Conference of the International Society of Travel Medicine, Washington DC, USA.

Lectures and Seminars

LSTM's Seminar Series is now a well-established part of the academic year. It provides a platform for LSTM researchers to present their work, generate visibility and gain some science communications experience by speaking to a wider audience than their immediate peers. External speakers are invited to present their work and research methodologies to inform, engage and inspire LSTM staff, students and external audiences via the live stream and recording provided.

External speakers included MSF's Secretary General, Chris Lockyear. Over the past year LSTM increased its cooperation with MSF and the Humanitarian Conflict Response Institute (HCRI) of the University of Manchester. They jointly launched a bespoke higher education programme designed for humanitarians from around the world (the so-called LEAP programme)

Other external speakers included José Gomez-Marquez who directs the medical technology design of Little Devices at Massachusetts Institute of Technology and spoke at LSTM on 'Construction Kits for Health'.



Rt Hon Nick Herbert MP

IVCC's CEO Dr Nick Hamon talked about 'fostering innovation in vector control', whereas the CEO of EDCTP, Dr Michael Makanga, spoke about the role of his funding agency in poverty related infectious diseases research & development.

The co-chair of the All-Party Parliamentary Group on TB, Rt Hon Nick Herbert MP, gave a seminar on 'Global political leadership to end TB' and was reporting back on the UN High Level Meeting on TB, which he helped organising.

A number of newly recruited lecturers and senior lecturers with LSTM gave a seminar on their respective research topics. Dr Anne Wilson on 'vector control at a cross roads: policy and implementation'; Dr Eva Heinz on 'Klebsiella pneumoniae population dynamics and antimicrobial resistance' followed by Dr Tony Nolan on 'From genome editing to suppression of mosquito populations'.

All seminars and lectures can be accessed via the LSTM website.



Research Capacity Strengthening (RCS)

Hundreds of millions of dollars are expended annually on research capacity strengthening in low- and middle-income countries (LMICs). Until 10 years ago the evidence-base to inform RCS intervention design and evaluation as wholly undeveloped. Since then, LSTM's Centre for Capacity Research has become a global leader in RCS implementation science by: - leading an exponential increase in RCS research publications; - pioneering innovative RCS design and evaluation models; - contributing towards evidence-informed RCS guidelines; - collaborating with leading UK and international RCS funding/implementing partners. The Centre's evidence underpins major UK RCS investments and the Centre's implementation, learning and evaluation models are increasingly embedded in large-scale international RCS programmes.



LIVERPOOL SCHOOL OF TROPICAL MEDICINE

Memoir (New Series) No. 1

GUIDE TO THE STUDY OF TSETSE-FLIES

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AND
W. H. POTTS, B.A. (Cantab.)

FOREWORD BY
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With three coloured and twenty-five plain plates, four maps and fifty-nine text-figures

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Publications

The Online Archive brings together LSTM's published research outputs into one central repository, ensuring that they are made available worldwide. The Online Archive can be accessed via: <https://archive.lstmed.ac.uk>



Research consortia hosted and managed by LSTM



The African Research Collaboration on Sepsis (ARCS)
Establishing centers of sepsis research excellence in Alawi, Uganda and Gabon
Funded by: NIHR
Web address: www.lstmed.ac.uk/ARCS



The African Snakebite Research Group
Aiming to significantly and sustainably improve health outcomes after snakebite in sub-Saharan Africa
Funded by: NIHR
Web address: www.lstmed.ac.uk/the-african-snakebite-research-group



ARISE
ARISE is working in partnership with marginalised people in informal urban spaces towards improving accountability for their health and well-being, in Bangladesh, Kenya, India and Sierra Leone
Funded by: UKRI
Web address: www.ariseconsortium.org



COUNTDOWN
Investigating solutions to control and eliminate the seven most common NTDs by 2020
Funded by: UK Department for International Development
Web address: www.countdownntds.org



Drivers of Resistance in Uganda and Malawi (DRUM)
Investigating the drivers of antibiotic resistance in Uganda and Malawi
Funded by: Cross-research council AMR initiative and NIHR
Web address: www.lstmed.ac.uk/DRUM



EHCR
Focusing on evidence in malaria, TB, child health, maternal health, and health systems. Preparing and updating Cochrane Reviews. LSTM hosts the Cochrane Infectious Disease Group
Funded by: UK Department for International Development
Web addresses: www.evidence4health.org and www.cidg.cochrane.org



IMPACT
Strengthening the evidence around cardiac safety and drug-drug interactions with Arvs
Funded by: European Union/EDCTP2
Web address: www.lstmed.ac.uk/research/collaborations/impact



IMPACT
Translating global malaria in pregnancy policy to country-level policies and clinical guidelines.
Funded by: European Union/EDCTP2
Web address: www.lstmed.ac.uk/research/collaborations/impact



IMPACT TB
Finding and treating TB cases in communities in Nepal and Vietnam
Funded by: European Union/Horizon2020
Web address: www.impacttbproject.org/



International Multidisciplinary Programme to Address Lung Health and TB in Africa (IMPALA)
Improving the health of children and adults in Africa through multi-disciplinary applied health research on lung health and TB
Funded by: NIHR
Web address: www.lstmed.ac.uk/impala



IMPROVE & IMPROVE-2
Conducting research into alternative drug regimens for women with malaria in pregnancy in Tanzania, Malawi and Kenya
Funded by: European Union EDCTP2
Web address: www.lstmed.ac.uk/research/collaborations/improve



Malaria in Insecticide Resistance Africa (MIRA)
Quantifying the public health impact of insecticide resistance and estimate the finances required to meet malaria control targets in high burden countries where malaria is persistent
Funded by: Wellcome Trust Collaborative Award
Web address: www.mira.lstmed.ac.uk



Partnership for Increasing the Impact of Vector Control
A partnership to reduce the burden of vector-borne disease through effective, locally appropriate, sustainable vector control
Funded by: Medical Research Council
Web address: www.piivec.org



Perform2Scale
Scaling up health management strengthening interventions
Funded by: European Union/Horizon2020
Web address: www.perform2scale.org



REACHOUT
Strengthening the vital work of close-to-community providers of healthcare in Africa and Asia
Funded by: European Union
Web address: www.reachoutconsortium.org

Tropical Infectious Diseases Consortium
A collaboration between LSTM, the London School of Hygiene and Tropical Medicine (LSHTM), the Jenner Institute at Oxford University and Public Health England, managing the MRC Confidence in Concept funding for individual projects that accelerate the transition from discovery science into therapeutic, diagnostic and vaccine development.
Funded by: Medical Research Council

LSTM Pioneers

Professor Brian Gilmore Maegraith CMG, MA, MB, BS, DPhil, DSc, FRCP (1907 – 1989)

Dean of LSTM (1946-1975), LSTM's Mary Kingsley Medal recipient (1973).

Australian by birth, he served in France and Sierra Leone as a pathologist in the Royal Army Medical Corps, led the Malaria Research Unit at the University of Oxford, held the Deanship of Faculty of Medicine at Oxford, and was appointed to the Chair of Tropical Medicine at LSTM in 1944.

Professor Maegraith foresaw the escalation of air travel and the increasing importance of imported diseases, with people arriving from tropical areas well within the incubation period of potentially dangerous infections - the most important of which was malaria. His classic paper 'Unde venis' published in The Lancet (1963) emphasizing

the importance of taking a geographical history, is as pertinent today as it was when it was first published.

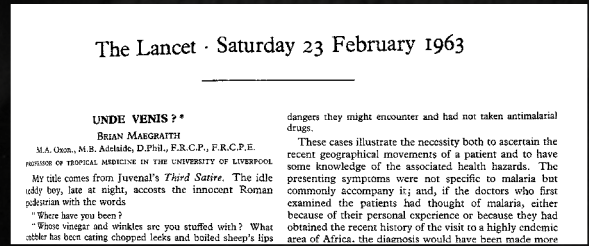
Maegraith helped to establish the Faculty of Tropical Medicine, part of Mahidol University, in Bangkok, Thailand; had close links with universities in Nigeria and Ghana; wrote several books such as Clinical Methods in Tropical Medicine and was a past president of the Royal Society of Tropical Medicine and Hygiene (RSTMH).



Professor Brian Maegraith welcomes Queen Elizabeth II to LSTM (1954)

LSTM honoured his legacy by the creation of the 'Maegraith Wing'

In 2008 his papers and personal collection of published material were donated to LSTM's archive.



Public Benefit Statement

The charity trustees of the Liverpool School of Tropical Medicine are its Board of Trustees who have had due regard to the Charity Commission's guidance on Public Benefit, and particularly to its supplementary public benefit guidance on purpose, which primarily for LSTM, is the advancement of education and research, and advancing health/saving lives.

Although primarily concerned with teaching, learning, research, knowledge transfer, and the development of the potential of its students, both for their own sake and to serve the needs of society and the economy, LSTM also plays a major role in shaping a democratic, sustainable, and inclusive society by striving for its research to impact policies and implementing practices.

These distinct purposes inevitably impact on its governance structures and practices, including in the need to engage both staff and students in the governance of their institution and a clear recognition of the importance of public benefit.

Public benefit reporting is also an increasingly important aspect of LSTM's transparency and accountability, and this helps the staff, students, and the wider public appreciate what activities LSTM delivers in return for both public funding and tax exemptions. A representative record of those activities is published throughout this Annual Report and Financial Statements.

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