2017 2018

ANNUAL REPORT

LSTM
LIVERPOOL SCHOOL
OF TROPICAL MEDICINE

Since 1898

Contents

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

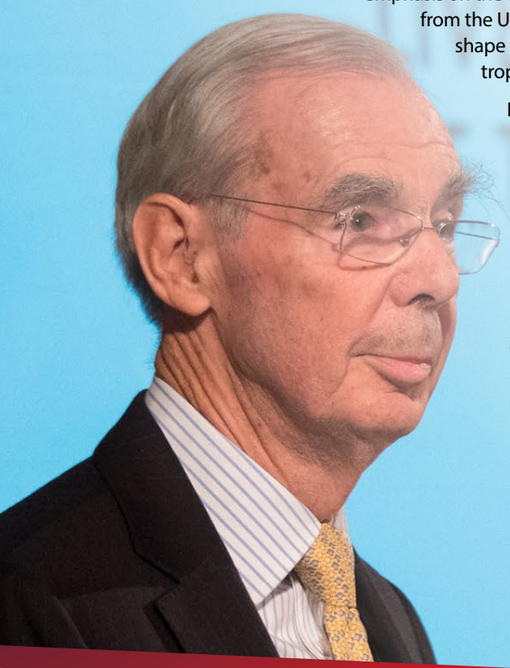
Women washing clothes in Arua, Uganda. Vector control is centered around river networks and aims to reduce contact between people and flies.

Chairman's Foreword

The time has come to celebrate the remarkable seventeen years of Janet Hemingway's directorship. It's not a time to say farewell because she will continue to be very active in LSTM's research and teaching activities. But she will step away from the leadership of the institution, with the profound thanks of all of us who have supported her in the transformation of LSTM. She hands on an organisation in very good shape to face the challenges which a fast-changing world will present.

Her successor, Professor David Lalloo, currently Dean of Clinical Sciences and International Public Health at LSTM, will bring to the job not only a deep understanding of LSTM, but also a very different experience from his predecessor. He was chosen through a rigorous recruitment process, against stiff external competition, by the unanimous vote of all members of the selection committee. I look forward to working with him and expect to see a constructively different approach to the development of LSTM emerging over time.

Meanwhile, as this annual report will show you, LSTM continues to develop on all fronts, not least of which is the relatively new emphasis on the teaching dimension of the portfolio. The appointment of Professor Philip Padfield from the University of Manchester, as Dean of Education, is a significant move as he will shape LSTM's impact on the next generation of clinicians and researchers in the field of tropical medicine.



December 2018 marks the first graduation ceremony of the Liverpool School of Tropical Medicine – until now our students have received awards from the University of Liverpool. This symbolises LSTM's own graduation to become a Higher Education Institute in its own right, with degree awarding powers.

Janet Hemingway's tenure has been marked by a very rapid expansion of staff numbers. This brings its own demands and stresses. We are delighted to welcome Sam Airey as the new Director of Human Resources and look forward to her contribution to the management of this international organisation.

So, it's a grateful farewell to her, Janet, and a warm welcome to him, David.

James Ross

James Ross OBE

"LSTM continues to develop on all fronts, not least of which is the relatively new emphasis on the teaching dimension of the portfolio."

Director's Foreword

This year has been one of transition for LSTM. Our plans for refreshing and expanding our learning and teaching offering have gathered pace. Professor Phil Padfield has joined us from the University of Manchester as the new Dean of Education, our first on line modules have been launched and the new Global Health Masters Programme is being established.

The evolution to a new senior management team has started. Earlier this year we said goodbye to the Director of Human Resources Chris Greenway and in November welcomed the new Director of Global Human Resources, Samantha Airey. The search for my successor was successfully completed and I am delighted that after a thorough competitive process Professor David Lalloo, was selected to lead the organisation. He will formally take over from me on the 1st January 2019. Other members of the senior team will remain to support David as he looks to shape the next chapter in the organisation's history.

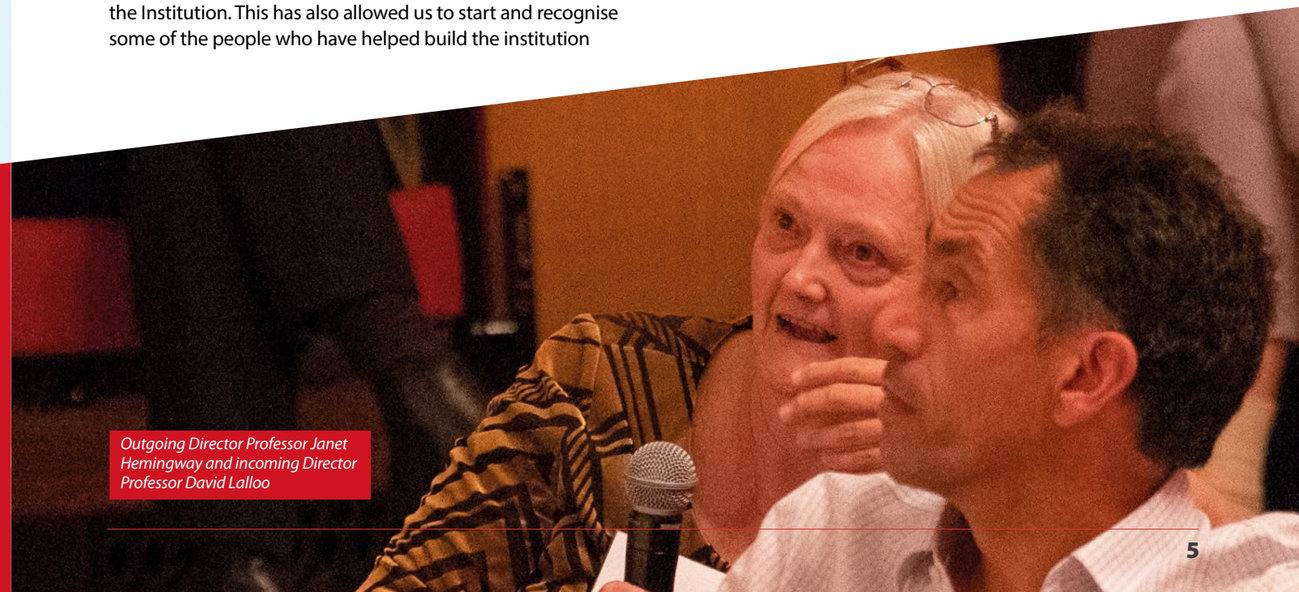
LSTM's research portfolio goes from strength to strength with a robust breadth of donors and funders that should allow us to weather any uncertainties that Brexit causes within the higher education sector. Turnover this year is again a record high, with a healthy surplus to allow us to continue to invest in our staff and facilities.

I am delighted to be presiding over our first Degree Awarding Ceremony in December of this year, with the first batch of students graduating under LSTM's Degree Awarding Powers. This will be a landmark date not only for our students but for the Institution. This has also allowed us to start and recognise some of the people who have helped build the institution into the leading organisation that it is today. The first of our Honorary Graduates are both from Africa. Letitia Obeng being one of our early Masters students and a pioneer in women's education in Ghana, while Victor Mwapasa has had a long standing association with LSTM and has helped develop and support the links between LSTM and the College of Medicine in Malawi. We are delighted to be able to honour their contributions to LSTM.

As this is my final Director's foreword, I want to take the opportunity to thank the Senior Management Team at LSTM, who have been a pleasure to work with, the Board of Trustees who have given up so much of their time and energy to support LSTM and myself in the Director's role, my office support staff, who have provided a superb service and all the staff at LSTM that make this such a great place to work. I will miss leading the organisation but am delighted that it is handed over to David in great shape and am sure that it will thrive under his leadership.

Janet Hemingway

Professor Janet Hemingway CBE FRS



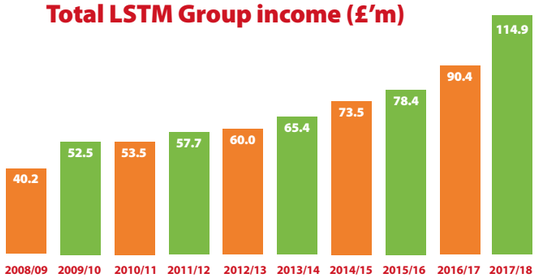
Outgoing Director Professor Janet Hemingway and incoming Director Professor David Lalloo

Treasurer's Report

For the tenth successive year the LSTM Group is able to report a record level of income. The reported total income exceeded £200m for the first time in LSTM's history. The total surplus for the year was £4.8m and Group net assets at the year-end were £50m.

LSTM Group income totalled £232m (2017: £209m). This included £118m (2017: £119m) of 'gifts in kind'. The gifts in kind were pharmaceutical drugs relating to a DFID mass drug administration programme in several African countries, and mosquito nets used for an insecticide effectiveness study in Uganda. Excluding the gifts in kind, LSTM reported a total income of £115m (2017: £90m), which represented a 27% increase over the previous year. The increase in income was used to increase the expenditure on research and academic activities.

Total LSTM Group income (£'m)



Excluding gifts in kind

Our surplus for the year was £4.8m (2017: £5.2m). As with the prior year, this figure was impacted by some non-recurring items which boosted the reported surplus. Specifically, we benefitted from a net tax credit from HM Revenue and Customs of £2m relating to expenditure on Research and Development. We also received a £1.1m grant from the Wolfson Foundation relating to expenditure on the Accelerator Building. Excluding these items, our surplus would have been £1.7m which we view as satisfactory and which was ahead of our budget.

Group net assets at the year-end totalled £50m. Excluding deferred capital grants of £26m (which are unlikely ever to be repaid), net assets totalled £76m. 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 £221m (2017: £188m), which have yet to be spent and this figure has increased since the year end.

Looking ahead, following the granting of degree awarding powers, we have expanded our investment in educational activities and expect to see good growth in this area in the current year.

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

Jon Schofield

Jon Schofield BA ACA

> "Looking ahead, following the granting of degree awarding powers, we have expanded our investment in educational activities and expect to see good growth in this area in the current year."

Retirement of Professor Janet Hemingway CBE FRS as Director LSTM

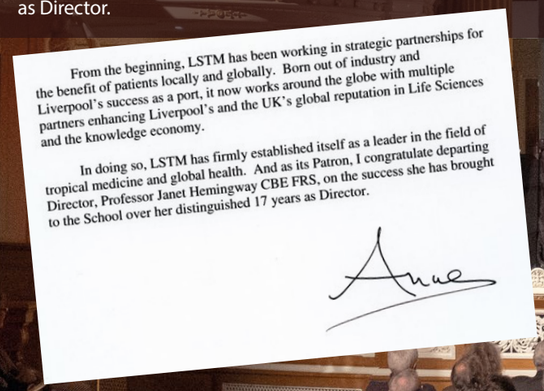
Just over a year after Professor Janet Hemingway announced her intention to retire as Director of LSTM, a two-day event was being organised to mark her forthcoming departure and to look back on her achievements as a scientist and Director.

Hosted by BBC Radio 4 Presenter, Professor Jim Al Khalili OBE FRS, in the beautiful surroundings of the Concert Hall of Liverpool's St George's Hall, the afternoon took the audience through Professor Hemingway's childhood love of animals, her determination at school to study science and her career before and during her 17-year tenure at LSTM. Beginning with an introduction from LSTM's Chair of Trustees, James Ross, there were contributions in person and by video from people all over the world.

A recurring theme was Professor Hemingway's qualities as a mentor, with Dr Abdoyoulaye Diabate, the group lead of Vector Biology and IRSS in Burkina Faso, saying that she was noted for her support of many young scientists and her remarkable influence, particularly across Africa. Many talked about her encouraging them to take paths that they may not have considered initially, including LSTM's Professor Hilary Ranson, who said that she seemed to have an ability to see into the future and understand how to play to people's individual strengths.

LSTM's Deputy Director, Professor Steve Ward, talked about her time at LSTM, taking the research copy book from £23 million to half a billion, improving the estates and tripling staff numbers. Over her 17 years as Director she has achieved all that she set out in her initial meeting with staff, with LSTM receiving Higher Education Institution status and degree awards powers, as well as restoring its global influence by attracting the best researchers, improving research output and impact whilst training the next generation of leaders in global health.

Professor Hemingway was presented with a framed letter from LSTM's Patron, HRH the Princess Royal, praising LSTM for establishing itself as a leader in the field of tropical medicine and global health and congratulating Professor Hemingway on the success she has brought to LSTM over her distinguished 17 years as Director.



From the beginning, LSTM has been working in strategic partnerships for the benefit of patients locally and globally. Born out of industry and Liverpool's success as a port, it now works around the globe with multiple partners enhancing Liverpool's and the UK's global reputation in Life Sciences and the knowledge economy.

In doing so, LSTM has firmly established itself as a leader in the field of tropical medicine and global health. And as its Patron, I congratulate departing Director, Professor Janet Hemingway CBE FRS, on the success she has brought to the School over her distinguished 17 years as Director.

Anne

Presenter Jim Al-Khalili, Professor Janet Hemingway and Professor Hilary Ranson listening to an audio message from Dr Abdoyoulaye Diabate

Chairman James Ross returned to the podium to announce the establishment of the Hemingway Fellowship. Reflecting her support for early career researchers and desire to attract the brightest and best to LSTM, the Fellowship will be awarded every three years from 2019 and will include salary and project seed money.

On the second day over 200 delegates attended a scientific conference in honour of Professor Hemingway by looking at the role of vector control in disease elimination. Welcomed by LSTM's Professor Hilary Ranson the day was split over four sessions and covered neglected tropical diseases, malaria, emerging technologies and opportunities and future challenges.

The conference was closed by LSTM's incoming Director, Professor David Lalloo. He described the event as a fitting tribute to Professor Hemingway, highlighting her contribution not only to LSTM, but to the wider field of tropical medicine and global health. Tamar Ghosh, CEO of the Royal Society of Tropical Medicine and Hygiene (RSTMH), announced a new award which will be given jointly with LSTM from 2019. The Hemingway Award will be a cash prize, named in recognition of Professor Hemingway's achievements in delivering and encouraging translational science during her leadership of LSTM. It is available to early career researchers and professionals from anywhere in the world.

Professor Janet Hemingway is succeeded as Director by Professor David Lalloo on 1 January 2019.

The event underway in St George's Hall, Liverpool

Retirement of LSTM's Senior Professorial Fellow David Molyneux

Professor David Molyneux stepped down from his role as LSTM's lead on Neglected Tropical Diseases (NTDs) in July. Early September a day of celebration was held in honour of his half-century professional career in the field of tropical medicine (1968-2018). The culmination of the day was the granting to Professor Molyneux by outgoing Director, Professor Janet Hemingway, of LSTM's highest award, the Mary Kingsley Medal.

LSTM's Director Professor Janet Hemingway CBE FRS said: "It has been fantastic to work with David, whose contributions, particularly in the field of neglected tropical diseases, cannot be overstated. It is LSTM's greatest honour to award him the Mary Kingsley Medal. The award represents LSTM's ethos of equity and partnership in relation to improving health across the world, all of which is demonstrated by David's tireless advocacy on behalf of the billion or more people globally at risk of contracting an NTD. He has been inspiration to so many and this award is thoroughly deserved."

On receiving the Medal, Professor Molyneux said: "This is overwhelming - I have to say thank you to Janet and to LSTM whose contribution has been extraordinary. Receiving the Mary Kingsley Medal is beyond expectation - with the number of people receiving it so small but their distinction is self-evident. It is something that I will treasure for the rest of my life."

The award ceremony came at the end of Professor Molyneux's retirement event, hosted at the Liverpool Medical Institution. It was opened by LSTM's Professor Mark Taylor, who welcomed what he described as "a who's who of tropical medicine and global health." People had come from far and wide to pay tribute to Professor Molyneux, many giving talks about his impact in the field of tropical medicine, with personal accounts from people such as Professor Peter Hotez, Dean of National School of Tropical Medicine of the Baylor College of Medicine, USA; Professor Alan Fenwick, founder of the Schistosomiasis Control Initiative; Andy Wright, GSK's VP of Global Health Programmes and Dr Frank Richards from the Carter Center.


Professor David Molyneux with the Mary Kingsley medal

Professor Molyneux joined LSTM in 1968 as a Lecturer before departing for different and distant positions, later returning as Director from 1991 to 2000. He established the Lymphatic Filariasis Support Centre, now known as the Centre for Neglected Tropical Diseases, funded by the UK Government's Department for International Development as their first foray into funding a public – private partnership.

He has been instrumental in the promotion of the treatment of NTDs and was one of the field's pioneers who coined the term 'Neglected Tropical Diseases' given their link to poverty. His continued advocacy contributed to the London Declaration of 2012, which has seen billions of doses of drugs donated by the pharmaceutical giants to alleviate and eliminate diseases such as lymphatic filariasis, onchocerciasis and Guinea worm.

Professor Molyneux has been a member of numerous advisory and expert panels including for WHO, the Expert Panel on Parasitic Diseases and the Capacity Strengthening Working Group of the Strategic and Technical Advisory Group, for the Carter Center the International Task Force for Disease Eradication. He has published over 350 academic papers and received recognition in the form of medals and awards from the British Society of Parasitology and the Royal Society of Tropical Medicine & Hygiene, including their highest award, the Manson Medal.

Professor Molyneux will remain active as editor-in-chief for International Health, a journal from the Royal Society of Tropical Medicine & Hygiene.

Introduction to the Feature Articles

LSTM just celebrated its 120th anniversary. Throughout its long history it has continually evolved in line with global health priorities, with a focus on delivering throughout the translational research cycle. Building on our traditional strengths of discovery and delivery through our research and teaching programmes, the emphasis has always been on the generation of health solutions that can be deployed to impact the world's most disadvantaged people.

Over the past 20 years LSTM has gone through a period of phenomenal growth. In April 2018 the LSTM Group[1] reached another milestone as its orderbook for research grants and contracts income topped half a billion pounds for the first time in its history.

LSTM has always sought to address some of the biggest health issues facing some of the world's poorest communities. This latest milestone highlights the confidence our funders have in our ability to take innovation in science from the lab to the field to benefit those who need it the most.

Our research has impact. As assessed during the REF2014, which placed LSTM in 6th place out of 124 UK academic institutions in the impact category, positioning us amongst the top 5% of major research institutions in the UK. Our ambition is to improve even further on our research impact for the forthcoming REF2021. We will therefore expand our current research portfolios in order to drive genuine interdisciplinary activities through global partnerships with multiple stakeholders from academia, government, industry and non-governmental organisations.

The following impact case studies, feature articles and departmental updates highlight how we continue to improve the success rates of our translational pathway approach to develop new products; improve treatments and practices and implement policies to break the cycle of poor health and poverty.

Professor Steve Ward
Deputy Director


UNICEF's Patrick Kalonde (left in image) and LSTM's Chris Jones (right) taking water samples to establish whether mosquitoes are breeding in the shorelines of a reservoir in Malawi, while the drone flies overhead capturing high resolution imagery of the floating and submerged vegetation in the water

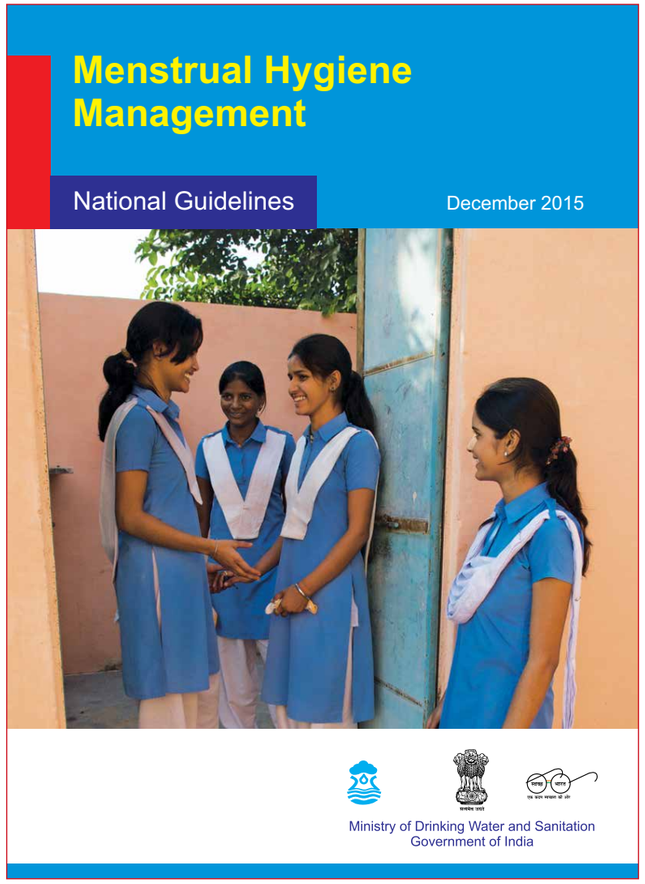
[1] *LSTM Group consists of LSTM, LSTM Consulting and IVCC*

Impact Case Studies

LSTM's growing contribution to research and global action for menstrual health

Young persons aged 10 to 24 years represent a quarter of the world's population, with 90% living in low or middle-income countries (LMIC); of these 500 million are girls aged 10-19 years living in less developed countries. Evidence of a positive association between girls' education, health and economic potential has strengthened resolve to improve this internationally. Menstrual health (MH) challenges girls in LMIC due to inadequate puberty education; poor water, sanitation and hygiene and supplies. A lack of sanitary products force girls to use unhygienic materials causing shame and discomfort. Studies in LMIC described potential effects such as lost dignity, school absence and dropout mostly using qualitative and descriptive methods. A paucity of empirical evidence on quantifying impact, drivers of risk, causal associations, or effectiveness of interventions prevented buy-in by international organisations or funders, yet such factors could predispose girls to increased risk HIV/STI, early marriage, high fertility, and thus contribute to health inequities.

In 2012, a first round of the UK-funded Joint Global Health trials (JGHT) award supported a collaboration between LSTM, Kenya Medical Research Institute (KEMRI), US-Centres for Disease Control (CDC), and Safe Water and AIDS (SWAP) to pilot the use and outcomes of menstrual cups versus sanitary pads, against controls' usual practice in 30 rural Kenyan primary schools. The collaboration also investigated MH needs across the study area, identifying 1:10 young girls engaged in transactional sex for money to buy pads. Pilot findings documented girls' MH challenges and suggested poor MH increased girls' risk of sexual and reproductive harms; e.g. girls in control schools had a two-fold higher prevalence of STI than 'cup' or 'pad' girls; girls with cups had a lower prevalence of bacterial vaginosis than 'control' or 'pad' girls; and dropout (with 50% due to pregnancy) was also lower but the pilot sample was inadequate to confirm a protective effect.



The collaboration's publications have supported research development with provision of guidance to advisory groups, workshops, meetings and conferences, including partnering a GCRF networking grant to strength MH research capacity in east Africa. LSTM, with Columbia University, supported Grand Challenges Canada with technical guidance for its global innovators. The safety findings provide the only rigorous evaluation supporting menstrual cup programmes.

LSTM presented to Government of Kenya stakeholders' roundtable in April 2016 and contributed to national policy, strategy and training guidelines for MH. Findings supported a JGHT award to examine menstrual cups and cash to improve girls' health, schooling, and equity in ~4000 Kenyan schoolgirls. Partnership with University of Illinois at Chicago generated a NIH grant to explore the effect of menstrual cups on the vaginal microbiome of post-pubertal girls, with implications for HIV, STI, and reproductive health. A UNICEF-invited grant enabled LSTM to collaborate with Tata Institute of Social Sciences to evaluate schoolgirls MH across India, and development of Government of India guidelines for MH for schoolgirls.

Networking began with a presentation on the JGHT pilot at the UNICEF/Columbia University-lead conference on MHM in schools, 2013. The following year saw formalised partnerships as a member of the MHM in Ten global strategy workshop in New York, publishing in PLOSMED; and stimulating scientific interest at a MH Symposia (American Society of Tropical Medicine). The collaboration with academics, institutions, and NGOs have widely published to galvanise international support for MH in schoolgirls, among women in the workplace, on non-menstrual bleeding (e.g. cervical ca) issues, developing robust research and Lancet commentaries. Now United Nations organisations are initiating action:

- LSTM supported UNFPA develop their East-South African MH Coalition call for action and presented evidence-to-date on the sexual and reproductive health consequences of inadequate MH at plenary, May 2018.
- WHO under Director Adolescent sexual and reproductive health held the first MHM expert panel, August 2018; LSTM presented guidance on research and programme implications of menstrual products; WHO outcomes include development of global guidelines for programmes, regulators and policy-makers world-wide.
- The Water Supply and Sanitation Collaborative Council (WSSCC) invited LSTM as an academic representative in an international MH Grand Coalition.

Further LSTM activities include presenting research at the Cup Summit 2018 and member of a Cup Coalition; invited to present on MH research priorities at the American Public Health Association-Women's Caucus in November 2018 and an invite by the Commonwealth Council for Education to present MH to Westminster parliamentarians the month before.

LSTM's growing collaborations internationally aim to strengthen action to prevent and mitigate MH and allied gender-health related disparities across the globe.

Understanding sepsis in resource-constrained settings

Since 2006, Dr Shevin Jacob's research has been focused on improving our understanding of sepsis predominantly in non-pregnant adults hospitalized in resource-constrained settings, primarily Uganda. His first study was an observational study to investigate the aetiology, clinical management, and outcomes associated with sepsis in a predominantly HIV-infected hospital population in Uganda. Dr Jacob and his group reported a high mortality in the setting of sub-optimal clinical management which led to a 2007-08 follow-up intervention study evaluating the impact of a fluid resuscitation protocol on adult sepsis patients. Administration of the protocol was associated with a 26% adjusted hazard reduction in the primary endpoint, 30-day mortality. They also reported a high frequency in this cohort of sepsis caused by Mycobacterium tuberculosis bacteraemia and derived a risk score comprising host factors for predicting this diagnosis.

Although limited by the before-and-after study design, these studies have been some of the first contributions to the sepsis management literature for sub-Saharan Africa, not only highlighting the challenges in managing sepsis in the region but also identifying possible opportunities for implementing low-cost, high-impact interventions in similar resource-constrained settings.

Accordingly, their findings have helped to inform clinical guidelines developed by the World Health Organization (WHO) for the management of adult sepsis in resource-constrained settings, now published in the WHO Integrated Management of Adolescent and Adult Illness District Clinician Manual. Through recent funding from the National Institute of Health Research and Medical Research Council, Dr Jacob continues to study important aspects of sepsis in sub-Saharan Africa, including epidemiology, early identification, clinical management, quality improvement, anti-microbial resistance, and post-discharge morbidity and mortality.

Because of a sepsis phenotype which manifests in various severe infections of public health importance, the WHO sepsis guidelines have been adapted for outbreak-prone infections as part of WHO emergency guidance during outbreaks, including the 2009 pandemic influenza A (H1N1) and 2013-2016 West Africa Ebola outbreaks.

During the Ebola outbreaks in West Africa (2013-2016) and Democratic Republic of Congo (ongoing), Dr Jacob was deployed by the WHO for several roles including clinical management of patients with Ebola Virus Disease (EVD), training/mentoring health workers to work in Ebola Treatment Units, advising Ministries of Health on case management and infection prevention and control strategies, and, most recently, overseeing the administration of investigational therapeutics for EVD patients under compassionate use as a transition to administering the same therapeutics within a randomised controlled trial. Dr Jacob and his colleagues have published a number of research articles and commentaries reflecting the importance of EVD clinical management as part of the broader public health response.

HIV self-testing

Throughout 2018, there have been intensive global efforts to increase the proportion of people who know their HIV status, facilitated by the scale up of new testing approaches and technologies. In 2018, UNAIDS reported that 75% of adults globally were aware of their status, short of the 2020 target of 90% and masking disparities in status awareness. Remote rural populations, men, young people and key populations including female sex workers and men having sex with men tend to be less well served than other groups by standard clinic-based HIV testing. HIV self-testing (HIVST), where an individual collects their own sample and conducts and interprets the result, is a relatively new intervention that has been recommended by WHO as an additional testing strategy able to improve uptake and frequency of testing among both general populations and men. HIVST has high acceptability among general populations, young people, and key populations and has the potential for major health impact among people in sub-Saharan Africa and assist efforts to end the global HIV epidemic.

LSTM researchers, including Dr Peter MacPherson, Dr Miriam Taegtmeyer and Professor Frances Cowan and their teams, have led a decade's worth of research into HIV self-testing, spanning from initial feasibility studies in Malawi in 2009 to large cluster-randomised trials of effectiveness and multicounty evaluations of implementation across Southern Africa.

Preliminary research studies showed that HIV self-testing was feasible and acceptable when offered through community members and had high potential to reach groups not otherwise well-served by HIV testing interventions, including men. A large prospective evaluation among nearly 17,000 adults in Blantyre demonstrated high and sustained uptake of HIV self-testing, with three-quarters of the entire adult population self-testing annually. LSTM has also led innovative research into improving access to HIV care and prevention services following HIV self-testing. In the first study of its kind, people in Blantyre who self-tested positive for HIV were three-times as likely to initiate antiretroviral therapy when treatment initiation was offered at home. In Zimbabwe, following extensive accuracy work, a randomised evaluation of campaign-style community-based distribution of 88,000 self-tests found that the proportion of adults 'ever tested' increased from 74% to 89% and that ART initiations increased by 27% in health facilities serving communities where self-tests were delivered. LSTM researchers have also been instrumental in showing that HIV self-testing is likely to be cost-effective if introduced at scale, increase population-level access to HIV treatment and prevention services, and have a low risk of adverse outcomes and of perpetrating stigma.

Rapid progress has been achieved in translating research findings into policy, regulation product development for HIV self-testing. Research findings have been quoted in WHO guidelines on HIV self-testing released in December 2016 and have directly influenced national policy and regulation of HIV self-testing in sub-Saharan Africa. This has enabled global scale-up and made it easier and more attractive for manufacturers to enter the HIVST market.

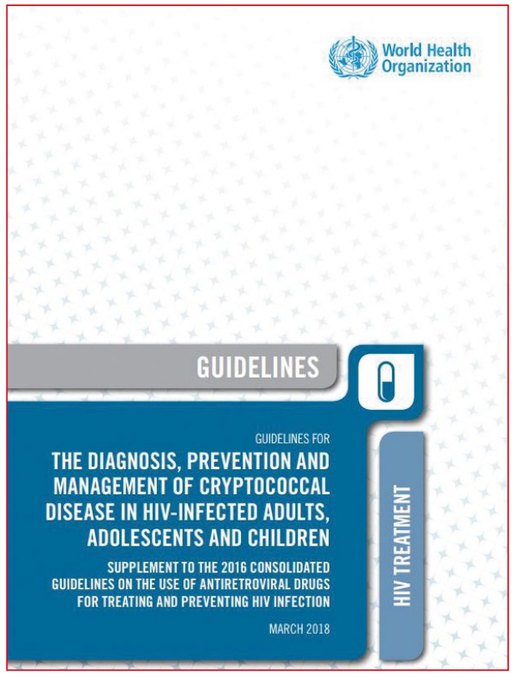
When LSTM and WHO co-hosted the first international meeting on HIVST in Geneva in 2013 there were no products for programmatic procurement in low- and middle-income countries (LMICs). Now there are 10 HIVST products in the pipeline, one that is WHO prequalified, and four others listed for procurement under "operational research" through the Global Fund. National and donor procurement of HIVST products in LMICs has risen from non-existent to an expected five million self-tests in 2018. LSTM researchers and their teams have identified common errors in instructions for use, developed demonstration materials and worked with manufacturers to ensure that intended users are able to correctly perform and interpret tests in the privacy of their own homes, allowing scale up to the remotest of areas and hardest to reach populations. LSTM is also a partner on the STAR Initiative, the largest HIV self-testing implementation project in the world.

Systematic reviews using evidence synthesis methods

Until the early 1990s, evidence synthesis was not part of medical currency and certainly had not touched tropical medicine. LSTM Professor Paul Garner, along with colleagues Hellen Gelband who was with the Health Technology Assessment Office in Washington and Piero Olliaro from the TDR, part of the World Health Organization (WHO), set up and registered the Cochrane Infectious Diseases Group (CIDG) in 1994. This group committed to preparing systematic reviews using Cochrane evidence synthesis methods in health problems of the tropics.

Early reviews, drawing on unpublished studies and francophone literature, broke new ground. One review showed that amodiaquine resulted in higher cure rates compared to chloroquine for treating malaria. A meta-analysis of 'low osmolarity' oral rehydration salt (ORS) solution led to a global change in the formula of ORS worldwide. Suddenly, CIDG had demonstrated the power of these methods in disease global policies.

CIDG's co-ordinating editor, Professor Paul Garner, saw that there were several cluster-randomised trials of insecticide treated mosquito nets for preventing death in children being conducted, facilitated by the WHO. He persuaded Christian Lengeler from the Swiss Tropical Institute to take the Cochrane approach and synthesize the evidence across all the trials in a single Cochrane review. At the time, there were no statistical methods for dealing with the design effects in cluster-randomized trials, but the CIDG engaged specialist statisticians in health services research in Canada who had started on these methods. The review was published in 1998 and updated in 2004 once the methods of 'reverse variance' had been developed so confidence intervals around the meta-analysis were possible (now termed the 'inverse variance' method). The results were extraordinarily important, demonstrating a clear impact on mortality: 5.5 lives were saved every year per 1000 children protected. The confidence intervals and the certainty around the estimates were pivotal in underpinning the investment in insecticide-treated nets (ITNs) in the following decade, and the review has been cited 1767 times.



As always with Cochrane, the editorial team advancing the methods and helping people apply them stayed in the background. Cochrane has never been about centre-staging the staff and academics that help get the reviews done - it looks for modesty and generosity in its partners; to help a research field summarize research in a scientifically defensible way, free of conflicts of interest and the spin that may happen when specialists review their own research. Whilst the Cochrane team have gone on to advance synthesis and support (or sometimes challenge) policies in global health, vector control stayed out of the mainstream evidence synthesis flow, mainly as the specialists thought it was not relevant to them. The CIDG team in Liverpool however continued their work, collaborating with LSTM Director, Professor Janet Hemingway, on reviews of sonic repellents; and another larger review examining the impact of entomological resistance on mortality and behaviour of mosquitoes.

However, over the last few years the tide has begun to turn. The WHO Global Malaria Programme (WHO GMP), which has worked with the CIDG for 15 years, has recently teamed up with the Entomology & Vector Control Unit (EVCU) at the WHO GMP to help ensure vector control guidelines are more in line with current evidence-informed scientific approaches. The CIDG were asked to assist, given their recognized excellence in the methods of evidence synthesis and knowledge in malaria. A whole suite of reviews was prepared using Cochrane methods on topics including: indoor residual spraying added to ITNs; insecticide space spraying; piperonyl butoxide (PBO) nets' effectiveness in the presence of insecticide resistance; and an update of existing Cochrane reviews on larviciding and the use of larvivorous fish. In addition, the original 2004 ITN review was updated using advanced GRADE methods for assessing the certainty of the evidence. The young research team, Joseph Pryce and Leslie Choi, along with CIDG statistician Marty Richardson, used innovative methods to estimate confidence intervals for the space spraying review. This is the first time this has been achieved with a disease that showed seasonality in interrupted time series analysis designs.

"These reviews support WHO's strategic decision in vector control to move away from expert opinion to evidence-based recommendations", said Jan Kolaczinski, EVCU Coordinator. The initial suite of seven Cochrane reviews underpin the first edition of the WHO malaria vector control guidelines to be published in 2019.

FEATURE ARTICLE

Neglected Tropical Diseases

A breakthrough in the past academic year was the recognition of the scale of the burden posed by snakebite and the need to engage effectively in identifying and implementing transformative remedial systems. With the support of the Kofi Annan Foundation, Médecins Sans Frontières, The Global Snakebite Initiative, Health Action International, some governments and several academics, the World Health Organization (WHO) listed tropical snakebite as a priority Neglected Tropical Disease in 2017. This was ratified by the Global Health Assembly in May 2018.

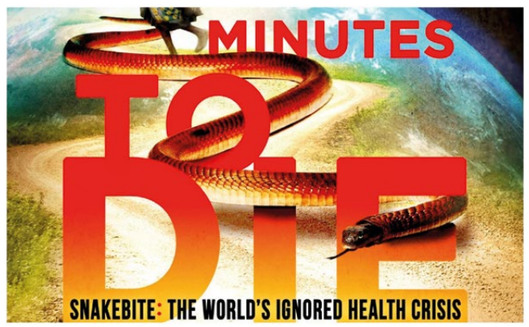
The WHO also instituted a sub-Saharan Africa-antivenom pre-qualification programme designed to identify effective and ineffective brands of antivenoms marketed in Africa, as part of a strategy to halve the global mortality and morbidity caused by tropical snakebite by 2030, including by subsidised provision of effective antivenoms to regions in greatest need.

These actions by the WHO have, in just 1-2 years, galvanised political opinion and transformed perceptions of snakebite in key health decision-makers in governmental, international and philanthropic donor agencies. It is imperative that this momentum for addressing the global burden of tropical snakebite is not lost. Donor agencies need to provide WHO with the investment it needs to implement its strategic plan. Investment is urgently needed to support clinical trials in tropical regions, particularly in sub-Saharan Africa, of existing and new antivenoms to ensure that inappropriate antivenoms are removed from distribution. Funding of survey work is needed to accurately identify where snakebite incidence, mortality and morbidity is greatest and thereby identify priority antivenom delivery routes. Funding to support capacity strengthening of local health infrastructures is vital to ensure victims can rapidly access effective healthcare. Finally, the scientific research community requires funding to develop, for the first time, new drugs and diagnostic tools that are effective against all regional snakes, and that are safe and affordable to tropical snakebite victims.

AFRICAN SNAKEBITE RESEARCH GROUP

Implementing this combination of outputs is central to LSTM's snakebite research remit in its continuing efforts to dramatically and sustainably reduce snakebite as a global health concern and demonstrate that the health needs of some of the world's most disadvantaged communities is no longer neglected. Thus, LSTM leads the African Snakebite Research Group that is providing substantial capacity strengthening measures to new centres of snakebite expertise (Snakebite Research & Intervention Centres) in Nigeria and Kenya – enabling them to implement outputs of their new clinical, socio-economic, therapeutic and health systems research to achieve these aspirations.

Advocacy for finding affordable, ground-breaking treatments for snakebite received a significant boost with the Lillian Lincoln Foundation funded documentary 'Minutes to Die', in which LSTM's research plays a significant role.



Eliminating Lymphatic Filariasis

LSTM's Centre for Neglected Tropical Diseases (CNTD), one of the main implementing partners of WHO's Global Programme to Eliminate Lymphatic Filariasis, continued to provide technical support to national NTD programmes in more than 20 countries across sub-Saharan Africa and Asia.

CNTD's programme has treated over 280 million people and trained over 500,000 people to administer the drugs within their communities. CNTD also focusses on treating those who with acute infections, predominantly swollen limbs (lymphoedema) and hydrocele (scrotal swelling). These conditions are often disabling and cause suffering to families as sufferers are frequently unable to work or participate in normal family life

Together with partners, Professor Molyneux published a Lancet Infectious Disease paper on the challenges of urban filariasis in West Africa. The publication attracted interest in key policy issues in respect of the needs of mass drug distribution in these complex and expanding environments given evidence that transmission of filariasis may not be occurring as evidenced by studies undertaken in several large cities in the region. The challenges of implementing NTD programmes generally in urban settings has generated revived interest given the trends in rural-urban migration not just in West Africa but also elsewhere in the tropics.

GAELF

The 10th meeting of the Global Alliance to Eliminate Lymphatic Filariasis (GAELF) in Delhi was crucial to maintain momentum as it heads to the initial elimination date of 2020 and then beyond. More than 300 delegates from each of the five WHO regions and GAELF partners attended the meeting to hear of and discuss the successes and remaining challenges to reach elimination. A new initiative of triple therapy (treatment of lymphatic filariasis with 3 drugs – ivermectin, albendazole and diethylcarbamazine) where it can be used, has shown in surveys to speed up the progress to elimination was a key focus of the programme.

Guinea worm

Before his retirement as LSTM's lead on NTDs, Professor Molyneux continued his work on Guinea Worm, with the WHO and the Carter Center, attending meetings of the International Task Force for Disease Eradication and as a member of the WHO International Commission for the Certification of Guinea Worm Eradication where he acted as rapporteur for the Commission in February and met with the WHO Director General. He later represented the Commission at the annual Meeting of Ministers of endemic and previously endemic countries at the World Health Assembly in May where he announced that the Commission had recommended the plan for a Global reward to be established for reporting Guinea Worm cases. As one of the few Eradication programmes Guinea Worm faces significant challenges as the emergence of reservoir hosts in dogs in Chad as well as dogs and baboons in Ethiopia.

Leishmaniasis

The ongoing Syrian crisis has resulted in the collapse of the health care system and the absence of control programmes, causing an exponential increase of leishmaniasis cases in the northern part of the country.

To learn more about this situation, Dr Alvaro Acosta-Serrano's team established a collaboration with the Syria Relief Network (SRN), an umbrella organisation of Syrian humanitarian NGOs

Emerging Guinea Worm from a dog's leg - credit Jared Wilson-Aggarwal

that provides essential support to communities affected by the conflict. Together with LSTM students Amina Olabi (MSc), India Hotopf (BSc), and Karina Mondragon-Shem (PhD), the team looked at leishmaniasis cases in 2016 and 2017 to understand the factors influencing the outbreak. More than 70,000 cases were reported in 2016, increasing to over 75,000 cases reported up to September of 2017. Factors such as destroyed housing, poor sanitation conditions, and delayed diagnosis and treatment all contribute to the escalation of cases. However, case reporting itself is heavily influenced by the numbers of active reporting centres and human mobility, which can vary unpredictably as the conflict changes.

To better identify the human perspectives on the leishmaniasis outbreak in Syria, through collaboration with SRN the LSTM team is currently conducting interviews on the ground to understand the experiences of patients and healthcare providers. Although logistically challenging, it is believed these experiences will shed some light on the more personal impact leishmaniasis has had on those living in the conflict. This could lead to improved support of healthcare staff and their patients in this and other situations of conflict.

Mental Health and NTDs

Professor Molyneux has continued to promote the mental health dimension of those suffering from NTDs and that of their carers. This work, supported by Sanofi, and assisted by Dr Freddie Bailey from Edinburgh, has focussed on studies on the global mental health burden of Cutaneous Leishmaniasis with Dr Acosta-Serrano and his team following earlier work on filariasis.

These studies together show that there is a uncalculated burden of mental health disability which outweighs the Global Burden of disease burden estimates for the disease themselves significantly and is presently not included in NTD burden estimates Studies on other disabling NTDs such as Buruli Ulcer have been initiated in Ghana and in collaboration with and support from Sightsavers, Dr Freddie Bailey spent a month in Ghana working on developing mental health support programmes for those with onchocerciasis and trachoma

Advocacy

Over the past academic year Professor Molyneux represented LSTM at the World Health Forum in Berlin and the Global Health Summit at Nagasaki University and meetings at the Carter Center, Geneva and the University of Exeter. He also attended Sightsavers' billionth treatment celebration hosted by the recently deceased Professor Hawking at the University of Cambridge. External advocacy of LSTM's NTD expertise and activities was conducted via representation at meetings including the International Society for Neglected Tropical Diseases and the All Party Parliamentary Group on Malaria and NTDs.

As a final note, LSTM is delighted with the announcement that Dr Mwele Malecela is the new Director of the WHO Department for the Control of Neglected Tropical Diseases. LSTM has had a working relationship with Dr Malecela since 2000 when support was provided to launch the national programme to eliminate lymphatic filariasis.

WHO's Dr Mwele Malecela with Professor Molyneux

At the Neglected Tropical Diseases NGO Network (NNN) Annual Meeting in Addis Ababa, the Royal Society of Tropical Medicine & Hygiene (RSTMH) announced the winners of their joint photo competition on the theme of neglected tropical diseases. The first prize was for Zikmund Bartoníček who took the photograph as part of his MSc at LSTM.

His winning image, which shared first prize with another image, is called "Shedding" and depicts exposing snails to sunlight to provoke trematode – and especially schistosome – cercariae shedding in Barombi Kotto, Cameroon. Zikmund had travelled to Cameroon as part of his MSc project with LSTM's Dr James La Course, Dr Martyn Steward and Professor Russell Stothard.

On winning the competition Zikmund said: "I took this picture when I was working on my masters' project at LSTM in southwest Cameroon. As part of my research, I was trying to detect schistosomiasis in the lake using environmental DNA detection and assessing how susceptible the intermediate freshwater snails are to lower doses of molluscicides so that the effect on non-target species are not as devastating and therefore more acceptable by local communities. Ultimately these efforts should allow us to detect and tackle schistosomiasis in the environment more efficiently as part of the integrated approach."

Department of Parasitology

The Department of Parasitology continues to lead internationally renowned research on the key tropical parasites, snakebite and antimicrobial resistance. Its research into new therapies, implementing alternative intervention strategies and disease surveillance policies have had a positive impact on the health of hundreds of millions of people in lower and middle-income countries.

Professor Mark Taylor - Head of Parasitology

Centre for Neglected Tropical Diseases (CNTD)

The Centre for Neglected Tropical Diseases is one of the main implementing partners of WHO's Global Programme to Eliminate Lymphatic Filariasis. CNTD's LF Elimination Programme has provided technical support to national NTD programmes in more than 20 countries across sub-Saharan Africa and Asia, funded by DFID, Glaxo Smith Kline (GSK) and End Fund.

The programme's overall goal is to treat 300 million people across 12 project countries with preventive chemotherapy to reduce disease prevalence and protect the population from the risk of infection and to date, CNTD's programme has treated over **280 million** people. Through national NTD programmes, treatments are given annually to everyone living in areas at risk of LF via a vast network of drug distributors and CNTD's programme has already trained over 500,000 people to administer the drugs within their communities.

CNTD's programme also focusses on treating those with clinical disease. The clinical manifestations of LF are predominantly swollen limbs (lymphoedema) and hydrocele (scrotal swelling), conditions that are often disabling and cause suffering to the patient as well as their families as they're frequently unable to work or participate in normal family life. The morbidity management and disability prevention component of the programme involves training health care workers and patients directly on how to manage lymphoedema and provides surgery for men with hydrocele. Across 8 countries, more than 25,000 men have had hydrocele surgery and 22,000 community health workers have been trained to provide lymphoedema care.

CNTD's project countries are making good progress towards elimination and the number of districts requiring mass drug treatments is reducing. To achieve such large-scale implementation, the programme involves building national capacity in areas such as pharmacy supply chain management and logistics, monitoring and evaluation and disseminating lessons learned and evidence on elimination strategies. CNTD has developed tools to improve access to diagnosis and treatment and for reporting on the quality of the services provided. Health workers report cases via mobile phone messaging (SMS) and tools to assess the quality of services and the number of patients accessing LF treatment and care are being trialed in 2018 and will be rolled out by 2019.

COU**NTD**OWN continues to generate high quality evidence using multi-disciplinary approaches to address the barriers to scaling up NTD programmes. For example, there have been several studies to assess the status of the lymphatic filariasis elimination programme in Ghana and to understand the adherence to interventions and their impact on transmission hotspots. Another example is the COUNTDOWN team in Cameroon advancing the concept of precision mapping for schistosomiasis, by demonstrating its significance and impact for equitable scale-up of preventive chemotherapy. Community drug distributors and their motivation levels has been a key focus, with a greater understanding on how community fatigue makes their work challenging.

Teaching session how to care for lymphoedema in Nepal

Centre for Snakebite Research & Intervention

The new created Centre for Snakebite Research & Intervention, led by Professor Rob Harrison, continues to grow and increasingly delivers translational 'bench to bedside' outputs to improve the treatment of tropical snakebite victims.

The National Institute of Health Research-funded 'African Snakebite Research Group' project has seen the establishment of collaborating units in Nigeria and Kenya (Snakebite Research and Intervention Centres) and significant progress on clinical research, health systems strengthening - to measure the medical and cost effectiveness of bespoke snakebite motorcycle ambulance and socioeconomics to define the cost of illness to snakebite victims and health infrastructures.

This year has seen a change in the perception of the public health burden of tropical snakebite. The WHO listing of snakebite as a priority Neglected Tropical Disease was ratified by the Global Health Assembly. The WHO formed a 'Working Group on Snakebite Envenoming' to devise a series of strategies designed to halve the current 138,000 deaths and 400,000 disabilities caused annually by snakebite by 2030 and a pivotal scientific conference, co-organised by Dr. Nick Casewell, 'Snakebite: from Science to Society', brought together a diverse group of scientists, NGOs, governmental officials and health professionals to develop new solutions for tropical snakebite.

Centre for Drugs and Diagnostic Research

A recent highlight in Professor Biagini's laboratory, includes the generation of new data into the mechanism of action of the antimalarial primaquine (PQ). PQ is the only currently FDA licensed drug, in clinical use, capable of killing dormant and proliferating liver stage parasites and circulating gametocytes, thereby reducing disease transmission. Despite over 70 years of use we still don't know how PQ works. The Liverpool team and collaborators from the Massachusetts Institute of Technology (MIT, USA), Rome (La Sapienza) and the London School of Hygiene and Tropical Medicine, have provide evidence of a host-dependent two-stage mechanism involving human host enzymes (cytochrome P450 2D6 (CYP2D6) and NADPH cytochrome P450 reductase) resulting in the formation of hydrogen peroxide (H_2O_2) in a process that is associated with parasite death. Professor Biagini has also continued drug discovery activities against Mycobacterium tuberculosis (Mtb), the causative agent of Tuberculosis (TB). The team have recently started a £1.25 million MRC-funded project with the TB Alliance, exploring the use of novel drug combinations targeting the respiratory chain of Mtb.

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ANTI-WOLBACHIA CONSORTIUM

The first ever 'designer' Onchocerca macrofilaricide clinical candidate, ABBV-4083 which was selected from the tylosin analogue macrofilaricide (TylAMac) series, through a partnership with AbbVie and DNDi, has entered safety trials in people. A 'back-up' candidate has been selected from the LSTM / University of Liverpool / Eisai Inc. azaquinolozine series. The pre-clinical candidate development of AWZ1066 has been funded by the MRC to progress the candidate to a point where it may enter clinical testing.

Dr Joe Turner's lab received further funding from the Bill & Melinda Gates Foundation in recognition of their important contributions to the Macrofilaricide Drug Accelerator. The consortium, consisting of multiple pharmaceutical and academic partners, is working toward selecting novel candidate drug cures for river blindness in 2019. Dr Turner's lab was also awarded a project grant from the National Centre for the Replacement Refinement and Reduction of Animals in Research (NC3Rs) to develop and validate alternative models to cats and dogs for testing veterinary anti-filarial drugs.

Diagnostics Development Group

The diagnostics development group, led by Dr Emily Adams, have begun a multi-centre study to identify a signature in exhaled breath to differentiate between viral and bacterial pneumonia, with patients recruited from NHS sites in Liverpool, Leicester and South Wales. This is important as such a test could help GPs and hospital doctors identify who needs antibiotics for respiratory tract infections, and who does not, sparing the use of antibiotics and potentially reducing resistance.

The group has also received funding to develop a molecular test enabling the detection of Crimean Congo Haemorrhagic Fever and Lassa fever, directly from blood. The test utilises the BioGene QuRapID platform, which enables direct detection in 50 minutes using qPCR, with a simple one-step method. Assay design work is underway, and the tests will be evaluated in Nigeria and Turkey in early 2019.

Anti-Microbial Resistance

Dr Adam Roberts group, now in its second year at the LSTM, investigates antimicrobial resistance and has secured further funding in the last 12 months from the MRC and the BBSRC and has secured one of 18 prestigious PhD studentships from the National PhD training programme in Antimicrobial Resistance Research; funded by the Medical Research Foundation. Adam's Swab and Send, a public engagement drug discovery project, has also continued to attract significant attention from the media and the public.

Malaria

The key protein that binds malaria infected red blood cells to blood vessels, called PfEMP1, is highly variable. This makes it difficult to analyse these variant proteins from patient samples. Working with colleagues at the Wellcome Trust Sanger Institute and the University of Oxford, Professor Alister Craig's team have been able to use a database of over 100,000 var genes to reconstruct the full-length var gene sequence. Using these in silico derived gene sequences they have shown concordance between the actual adhesion characteristics of the infected red blood cells and the binding domains from their respective predicted PfEMP1's. This work will help us to understand the nature of the interaction between the malaria parasite and the human host, and thereby design new interventions for severe disease. One such intervention might include antibodies identified by Dr. Britta Urban's team that block the adhesion infected red blood cells to the blood vessel wall receptor. These antibodies can now be exploited for the development of adjunct therapy for the treatment of severe malaria and rational design of vaccines.

Fellowship Success

Dr Samantha Donnellan has been awarded a prestigious fellowship from the Winston Churchill Memorial Trust, to help further her work with multi drug resistant tuberculosis (MDR TB) by funding her travel to work with colleagues in South Africa and the USA. Dr Ghaith Aljayyoussi was awarded a 3-year fellowship by the Medical Research Council (MRC). He will be working on using emerging techniques of machine learning and neural networks to predict the activity of drug combinations used against malaria. The work is expected to result in creating standardised platforms that will aid in the dose selection process for combined anti-malarial therapies in clinical studies.

We welcome a new joint appointment with the Vector Biology Department, Dr Grant Hughes. Soon after his arrival at LSTM, he was announced as one of the first recipients of the prestigious Royal Society Wolfson Fellowship. Dr Hughes will use the Fellowship to expand his team here at LSTM to continue his work on understanding the role of the microbiome on mosquito biology, and in developing novel control strategies to reduce mosquito-borne disease.

FEATURE ARTICLE

Malaria and other Vector Borne Diseases

Insects transmit many of the world's deadliest pathogens. In recent years interventions that target the insect vector have yielded some remarkable gains in reducing disease burden in endemic countries most notably with malaria, yet there is still a long way to go to end human suffering from vector borne disease. LSTM hosts one of the largest groups of medical entomologists in the world and is at the forefront of vector biology research seeking a diverse range of new and improved solutions that will reach this goal.

A decade of partnership with CNRFP, Burkina Faso

This year marked the 10th anniversary of collaboration between LSTM's Vector Biology Department and the Centre National de Recherche et de Formation sur le Paludisme (CNRFP) in Burkina Faso. The partnership began with a small TDR partnership grant in 2008 to track the spread of insecticide resistance in malaria vectors and has subsequently expanded to multiple projects. Throughout this period, the focus of our research has been on understanding the reasons for the stubborn persistence of malaria in Burkina Faso and identifying and evaluating alternative strategies to reduce the disease burden.

Despite implementing World Health Organization (WHO) recommended strategies, including three rounds of distribution of bednets across the entire country, malaria cases have risen year on year in Burkina Faso. To understand the reasons underpinning this longitudinal, multidisciplinary studies have been conducted. They have shown that conventional pyrethroid only bednets are ineffective at controlling the malaria mosquitoes in the southwest of the country whilst demonstrating that major reductions in malaria incidence could be achieved by switching to 'next generation' bednets. As a result of these findings, residents living in the regions most severely affected by insecticide resistant malaria vectors will receive nets specifically designed to target these resistant mosquitoes in the 2019 net distribution programme. LSTM will be working with CNRFP and other partners to evaluate the impact of this policy change. In addition to continuing the search for additional cost-effective tools to target malaria, LSTM is also widening its studies to look at other vector borne diseases prevalent in this region such as dengue and river blindness and have recently awarded four postdoctoral fellowships to Burkinabe scientists to accelerate this endeavour.

Tracking resistance to pyrethroids in malaria vectors

For the last decade LSTM has led the way in mosquito resistance research demonstrating how mosquitoes use their metabolic armory to cope with exposure to pyrethroid insecticides used on bednets. This resistance has spread across the African continent and threatens to seriously undermine the remarkable gains made in malaria vector control since the turn of the century.

Twenty years after the first DNA diagnostic for pyrethroid resistance in Anopheles mosquitoes the group led by Professor Charles Wondji have now overcome the complex task of elucidating the precise molecular basis of this metabolic resistance and designed the first DNA-based diagnostic assay for the group of P450-enzymes that are key to this resistance.

Conducting research across Africa in one of the major malaria vectors, Anopheles funestus, the group uncovered a mutation that leads to the over-expression of a specific P450 that metabolises the pyrethroid inside the insect. The detection of this mutation led to the design of a DNA-based diagnostic assay as a tool to detect and track the spread of resistance and revealed that the mutation is present across southern Africa but absent elsewhere. Furthermore, experimental hut studies demonstrated that resistant mosquitoes carrying the mutation survived and succeeded in blood-feeding more than susceptible individuals, highlighting the urgent need to introduce new generations of insecticide-treated nets that are not reliant on pyrethroids.

This work, funded through a Wellcome Trust fellowship to Professor Wondji, is important to designing resistance management strategies to maintain the recent gains in malaria control using insecticide-based tools. The diagnostic tool will help to detect and track resistance at an early stage, assess fitness costs to the mosquito often associated with such mutations and determine the impact on malaria transmission allowing control programmes to design rational, evidence-based resistance management strategies.

Drones for mapping mosquito breeding sites

This year saw LSTM pilot the use of drone technology as a high-tech solution to locating mosquitoes both at home and abroad.

Imagery of the Wirral marshland captured by a drone

Aedes detritus is a prolific nuisance biter on England's Wirral peninsular. This mosquito species breeds in the salt marsh of this tidal habitat with the eggs requiring repeated immersions with salt water to hatch. Mapping the entire marsh habitat on foot is difficult so one solution is to fly drones equipped with specialised cameras to photograph the area. Combining hundreds of overlapping images, repeated drone flights over an area of Wirral marshland produced detailed maps showing just how the habitat changes over the course of a season. By capturing high-resolution pictures of the marshland, the aim of this project funded by the National Institute of Heath Research is to demonstrate where and when Aedes detritus mosquitoes are at their peak numbers and when locals are more at risk from biting.

A similar project in Malawi, in collaboration with Lancaster University, the Malawi-Liverpool-Wellcome Trust and UNICEF, is exploring the feasibility of using drones to identify where Anopheles mosquitoes are breeding for targeting control efforts. In Malawi malaria remains a major burden with an estimated 4.5 million cases. Insecticide-treated bednets and indoor residual spraying (IRS) with insecticide have reduced malaria significantly, but more innovative approaches are needed. Reducing the mosquito population by removing fixed and findable mosquito breeding sites is an alternative supplementary approach. High-resolution imagery from drones could vastly improve the accuracy of this long-standing control method. In the summer of 2018 the project used Africa's first Humanitarian Drone Testing Corridor co-ordinated by UNICEF and aims to develop the drone technology so that it is cost-effective and user-friendly for National Malaria Control Programmes.

Mimicking human and animal cues to catch vectors

Work undertaken by LSTM in collaboration with the University of Greenwich and the Kenya Medical Research Institute is assessing a new method for catching outdoor biting mosquitoes. One of the biggest challenges facing malaria control is targeting vectors that do not show 'typical' indoor night biting behaviour that is exploited by insecticide treated bednets. Mosquitoes that bite outdoors are difficult to catch so new methods of surveillance are critical for targeting these vectors.

The Human Decoy Trap (HDT) is a hot, odour baited sticky trap, which can be used to sample mosquito populations. The trap, which is well insulated, is filled with 15L of boiling water to keep it warm. Different odours, such as carbon dioxide (CO_2), are used as an attractant. Mosquitoes are attracted to a combination of heat and odour and land on the sticky surface and remain stuck. The HDT has been used successfully to sample both Anopheles and Culex mosquitoes in Kenya as reported in a paper published in Parasites and Vectors. Closer to home, the trap is also being used to sample nuisance biting Aedes mosquitoes in the botanical gardens of the University of Liverpool. The studies have demonstrated that a hot, CO_2 baited HDT collects good numbers of mosquitoes and that the HDT offers an alternative trapping method to the current gold-standard of human landing catches for sampling human biting mosquito species.

Human decoy trap attracts outdoor biting mosquitoes

Mosquito Gene Function Analysis

A focus of the much of the research in the Vector Biology department involves using comparative DNA and RNA sequencing of wild caught mosquitoes to identify candidate genes that have evolved either mutations or overproduction in insecticide resistant insects. To complement this work, Dr Gareth Lycett's group has been developing tools to examine the specific role of these genes by directed genetic modification of mosquitoes.

Techniques have been developed that allow the products of individual genes to be highly downregulated or upregulated in Anopheles mosquitoes. Moreover, tools to precisely mutate individual genes have been incorporated into the repertoire of genome modifications available. These modified mosquitoes can then be screened for increased or decreased resistance to different panels of insecticides in order to validate their role in conferring the resistant phenotype. The modified mosquitoes are also used to screen novel compounds coming from the IVCC pipeline to discover the efficacy of new or repurposed chemicals against mosquitoes carrying stable, defined mechanisms of resistance. In doing so, we can gauge the potential for resistance to develop rapidly (or currently exist) against these new compounds.

Modified mosquitoes overexpressing a red fluorescent protein (top) and possessing mutations that change the eye colour from black to white (bottom)

Mathematical models for dengue and Zika mosquito control using bacteria

The Aedes aegypti mosquito is a disease vector for a number of arboviruses including chikungunya, dengue and Zika. An exciting current area of research in controlling the spread of these diseases is the use of a naturally occurring bacteria, *Wolbachia*, to suppress transmission. *Wolbachia* is a bacterial symbiont and when present in the mosquito reduces its ability to transmit the virus. Once *Wolbachia* infected mosquitoes are released into the population the frequency of *Wolbachia* infection grows and is self-sustaining until further releases are not required. Field-releases of *Wolbachia* mosquitoes have proved successful where their ability to spread the virus in comparison to non-infected, native mosquitoes, has been reported.

Research led by the group of Dr Gabriela Gomes outlines the importance of using variation in mosquito susceptibility to infection as a parameter in mathematical modelling to realistically assess the impact of *Wolbachia* infection on disease transmission. In a paper published in Nature Communications, Dr Gomes and her team analyse two independently generated datasets (from Brazil and Vietnam) and show that *Wolbachia* consistently increases the mean and variance in mosquito susceptibility to dengue viruses. Current mathematical models of disease transmission are conventionally parametrised by population averages, but the team shows that the variance in mosquito susceptibility critically impacts disease transmission and it is clear that disregarding this parameter could lead to misleading conclusions. This work shows that predictions of invasiveness and vectoral capacity of infected mosquitoes requires an informed account of their natural pathogens and how these interplay with *Wolbachia*.

Partnership for Increasing the Impact of Vector Control (PIIVeC)

The Partnership for Increasing the Impact of Vector Control (PIIVeC), launched in October 2017, is addressing the shortage of researchers working on new tools and approaches to control vector borne diseases. A team of multidisciplinary scientists have been appointed at LSTM and in partner countries, Burkina Faso, Cameroon and Malawi who collectively have a portfolio of research ranging from new traps for blackflies to tackle outbreaks of river blindness to an analysis of the global financing mechanisms for vector control. In order to provide supportive environments in which our African researchers can thrive, PIIVeC has been working with LSTM's Capacity Research Unit to undertake institutional research capacity assessments. Three of four partner institutes have now received the reports and are working to prioritise the list of recommendations. PIIVeC is also taking a variety of approaches to increase the use of evidence in setting national strategies for control of vector borne diseases. Country Coordinators in the three partner countries are establishing or strengthening technical vector control advisory groups, which will be key committees helping to translate evidence into policy. Project partners AFIDEP have been instrumental in guiding this activity and in helping all scientists in the project consider the translational pipeline of their work and the understanding the key messages to communicate to all different stakeholders at country and global level.

Dr Sagnon N'fale, PIIVeC country coordinator in Burkina Faso, speaking to the media after the launch

Drugs and malaria vaccine

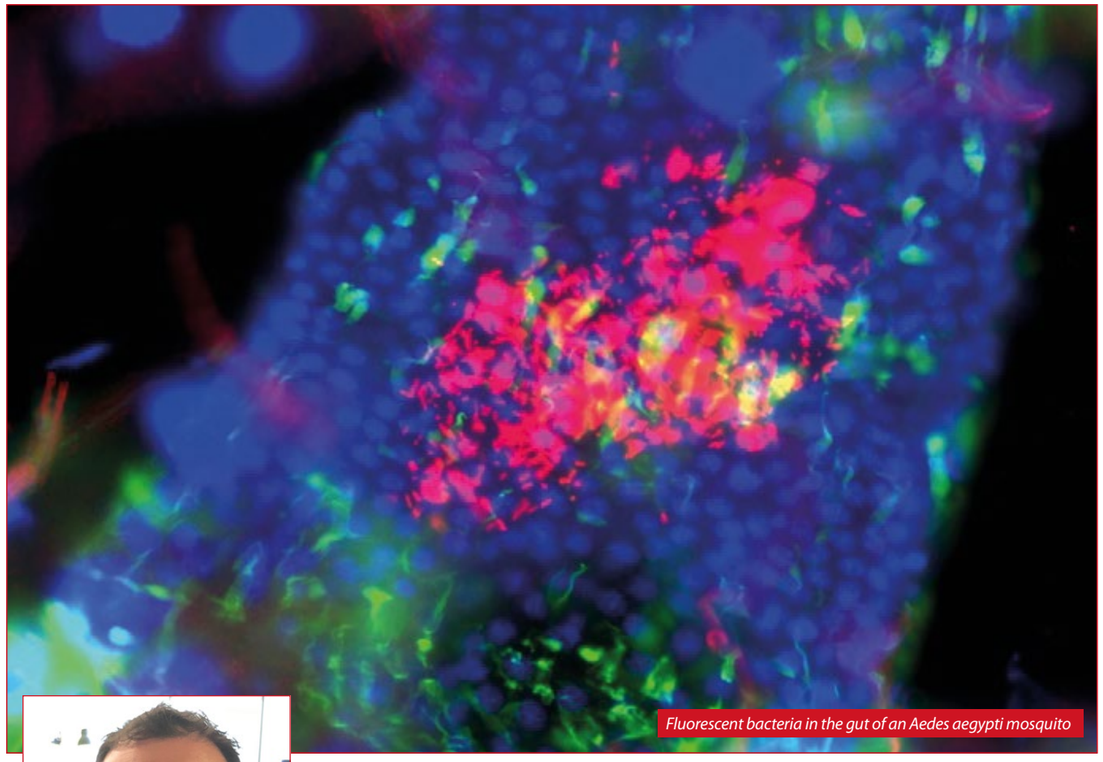
Professor Feiko ter Kuile, in collaboration with the Kenya Medical Research Institute (KEMRI) and the US Centers for Disease Control and Prevention (CDC) in western Kenya, completed an exciting study with ivermectin. This is an antiparasitic drug used for lymphatic filariasis and onchocerciasis that is now being considered for mass drug administration for malaria due to its ability to kill mosquitoes by making the blood poisonous for mosquitoes that feed on recently treated individuals. The study showed that higher doses of ivermectin were well tolerated and resulted in much greater mosquito mortality than previously reported with standard doses. These promising findings were published in The Lancet Infectious Diseases and received a lot attention. Seven population-based studies by other groups are now ongoing to confirm the potential role of ivermectin as a new tool for malaria control.

Dr Jenny Hill received funding to undertake a 3-year study in western Kenya to explore, in collaboration with other partners, the dynamics of the implementation of the world's first malaria vaccine as part of a multi-country evaluation in Ghana, Kenya and Malawi.

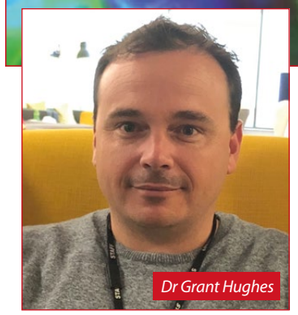
Department of Vector Biology

This has been an exciting year of expansion for the Department of Vector Biology with the appointment of four new faculty members. The diverse expertise these appointments bring will strengthen our discovery research in mosquito biology, the genomics of resistance, and in epidemiology and policy related research. They also provide excellent opportunities to reinforce links between LSTM departments via joint appointments and collaborative research projects.

Professor Hilary Ranson - Head of Vector Biology



Fluorescent bacteria in the gut of an Aedes aegypti mosquito



Dr Grant Hughes

Dr Grant Hughes has been studying how symbionts influence and interact with insect vectors for the past 15 years with the aim of developing novel microbial-based strategies to control arthropod-borne disease. After completing his PhD at the University of Queensland, he took up a postdoc position at Johns Hopkins University where he evaluated the use of *Wolbachia* for malaria control. His work was the first to demonstrate that *Wolbachia* can interfere with Plasmodium falciparum in Anopheles mosquito vectors. After moving to Penn State University, he continued working on *Wolbachia*-Anopheles systems and identified that the native microbiota of Anopheles impede the vertical transmission of symbiont in the mosquito vector. In 2016, Dr Hughes became an Assistant Professor at the University of Texas Medical Branch in Galveston and expanded the scope of his research to study the entire microbiota of mosquitoes. Here the focus of his research was to examine the tripartite interactions between the microbiome, the mosquito host and the arboviruses they transmit. These research themes will be continued at LSTM with an emphasis on exploiting the knowledge gleaned to developed applied symbiont-based strategies to combat vector-borne disease.

Dr Eva Heinz

Dr Eva Heinz, completed her Masters and PhD at the University of Vienna on host-pathogen interactions of environmental chlamydiae living in amoebae, before moving to Newcastle University where she studied the molecular evolution and comparative genomics of eukaryotic parasites. After a postdoc studying the evolution of bacterial outer membrane protein families at Monash University she was offered a position as senior staff scientist at the Sanger Institute, and joined the teams of Gordon Dougan and Nick Thomson.

Dr Heinz's current work is focused on understanding the impact antimicrobial resistance has on bacterial populations, as well as how much the genetic background and intrinsic mechanisms contribute to the success of some lineages over others. Following her move to LSTM she will continue to use genomic data to understand the evolution of resistance, as well as how the pressure of antimicrobials, but also pollution, household products, etc., has changed the species throughout the last century. Although her current projects are largely focused on bacteria, there are clear parallels between antimicrobial resistance and insecticide resistance and the arrival of Dr Heinz, with a joint position between Department of Vector Biology and Department of Clinical Sciences will foster opportunities for enhanced collaborative approaches to tackle resistance in all its forms.

Tony Nolan completed his PhD at Imperial College using transposable elements to develop the first transgenic technology for Anopheline mosquitoes. Subsequent postdoctoral work on the basic mechanisms of genome defense against invading genetic elements at the University of Rome and University College London eventually led him back to Imperial College. For the past 10 years he has been engaged in an exciting programme which aims to use selfish genetic elements for the purpose of genetic control of mosquito populations. This project led to the development of synthetic gene drive elements, based on nucleases such as CRISPR-Cas9, that have the capacity to copy themselves from one chromosome to another during gamete formation and thereby bias their inheritance among offspring. Dr Nolan developed a number of additional genetic tools that can be applied more generally to functional genetics in the mosquito and will be a great asset to the discovery research in the department. In addition to his interest in understanding and improving the molecular dynamics and robustness of gene drives, Dr Nolan intends to employ some of the same tools for the study of insecticide resistance, with a longer-term view of exploring potential synergies between gene drive programs and conventional insecticide control programs.

Dr Tony Nolan

Dr Anne Wilson, an infectious disease epidemiologist, works on treatment and control of malaria and other vector borne diseases (VBD). Her work has been on the theme of Integrated Vector Management (IVM) – the WHO recommended approach to vector control which calls for evidence-based and adaptive use of vector control tools and involvement of multiple sectors to control VBDs. She has authored WHO guidelines on IVM and vector control trial design, and synthesised evidence on vector control interventions. Dr Wilson is part of an inter-disciplinary network that aims to stimulate research on the role of the built environment in control of VBD.

Dr Anne Wilson

Dr Wilson has a PhD from Durham University and MSc from the London School of Hygiene and Tropical Medicine. She managed operational research projects on malaria diagnosis and treatment in Ghana and Zanzibar. Pre MSc, she worked in the pharmaceutical industry on regulatory affairs in emerging markets and clinical trial design. Dr Wilson will be continuing her work on IVM at LSTM including supporting the development of new vector control tools through conduct of rigorous trials. She also plans to work on multi-sectoral vector control responses, including investigating how to facilitate collaboration between the health and non-health sectors.

FEATURE ARTICLE

Resistance Research & Management

LSTM's Antimicrobial resistance (AMR) research activity has increased considerably over the last 12 months. Academics have been successful in combining expertise from different departments to secure significant funding to support multi-disciplinary research projects aimed at understanding AMR. LSTM investigators have been appointed to multiple policy advisory roles for national funding bodies and societies including the Wellcome Trust, the Fleming Fund and the Royal Society for Tropical Medicine and Hygiene and have continued to publish their research in high impact journals.

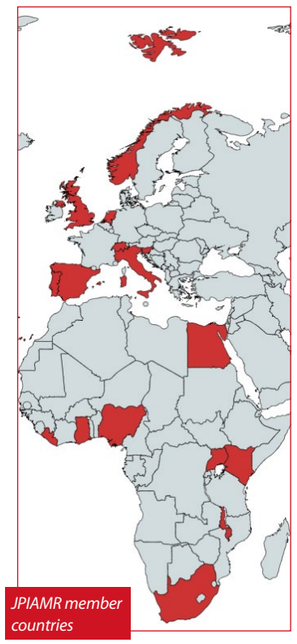
LSTM secured £3 million funding from the Medical Research Council's "AMR in a Global Context" call for a cross-departmental project led by Dr Nicholas Feasey and involving researchers from multiple LSTM research departments. This One Health project is aimed at determining the "Drivers of Antimicrobial Resistance in Uganda and Malawi" and is known as DRUM. The aim is to determine how human behaviour and antibacterial usage in the home, around animals and in the wider environment in urban and rural areas of Uganda and Malawi contributes to the spread of antibiotic resistance in bacteria.

Much remains unknown about how antibiotic resistance spreads globally, which is particularly true in sub-Saharan Africa, where diagnostic laboratories are not commonly available. The DRUM consortium will work collaboratively with teams in Uganda and Malawi to identify and understand the key drivers of resistance.

The DRUM consortium, made up of researchers from institutions across the UK and in Uganda and Malawi, will look particularly at the common bacteria Escherichia coli and Klebsiella pneumoniae. E. coli is an example of a bacterium that often causes infections in the community, but may also spread around hospitals, whereas K. pneumoniae is a key cause of hospital acquired infections, particularly amongst vulnerable groups such as premature babies. These closely-related bacteria share traits that make them resistant to antibiotics. Investigations will range from evolutionary biology and genomics, through to social science and economics and will all feed into a strong modelling component.

Members of the DRUM consortium at LSTM

In addition, researchers at LSTM have been successful in obtaining funding for an important network of researchers from Europe and Africa, co-ordinated by Dr Adam Roberts, from the Joint Programming Initiative on Antimicrobial Resistance (JPIAMR). The JPIAMR was formed in 2011 and is comprised of 26 countries; the majority of which are in Europe. It funds research on new antibiotics, stewardship, and the spread of antibiotic resistance between humans, animals, and the environment in a One Health perspective. It also supports research through several activities such as the establishment of a Virtual Research Institute (VRI). The newly funded LSTM led Network of European and African Researchers on AMR, known as NEAR-AMR, will contribute to the development of the JPIAMR's VRI specifically within the fields of global resistance surveillance and epidemiological data sharing and capacity building and capability strengthening, with a focus on training early career investigators throughout the two continents.



JPIAMR member countries

LSTM has also welcomed a new PhD student funded by the Medical Research Foundation (MRF) National PhD Training Programme in Antimicrobial Resistance Research. The new £4 million Programme, led by Bristol University, was officially launched in September this year at the Science Museum's Superbugs gallery by Professor Dame Sally Davies, England's Chief Medical Officer. It is the only national AMR PhD programme and currently funds 18 PhD studentships around the UK plus training and cohort-building activities for a wider cohort of 150 PhD students studying AMR across the UK. The first residential training course and conference for PhD students external to the programme was held in August 2018 at the University of Bristol and was attended by other PhD students from the Roberts group.

The MRF PhD student, also based in the Roberts group, is investigating plant derived compounds and their role as natural drivers of AMR in the environment and is co-supervised by Dr Andrew Singer from the Centre for Ecology and Hydrology (CEH); a world-class research organisation focusing on land and freshwater ecosystems and their interaction with the atmosphere. Dr Singer is also a member of the DRUM consortium and is co-supervising another LSTM PhD student within the Feasey group investigating AMR within Malawi. As a result of these strong links Dr Singer has been appointed as an honorary member of staff earlier this year.

LSTM also begun a new collaboration with The Antimicrobial Resistance Centre (The AMR Centre) funded by a MRC Confidence in Concept (CiC) grant. Established in 2016, The AMR Centre is a key part of the UK's response to the global threat from Antimicrobial Resistance. Based at Cheshire's Alderley Park, The AMR Centre is a joint private-public initiative to support and accelerate the development of new antibiotics and diagnostics. The project, led by LSTM and together with expert chemists at the University of Liverpool, aims to determine the potency of hybrid antibiotics; two different antibiotics joined together, against E. coli. The choice of antibiotics has been informed by evolutionary biology investigations involving the Roberts group which was published earlier this year in Nature Communications and demonstrates how fundamental microbiology investigations into AMR are able to be rapidly translated into clinically relevant research; something LSTM aims to do with all activities across its AMR research portfolio.

Centre for Drugs and Diagnostics Research

CDDR coordinator Professor Giancarlo Biagini

LSTM's Centre for Drugs and Diagnostics Research' (CDDR) public–private partnerships and delivery of translational projects help vulnerable people in resource-poor countries. The Centre comprises a multidisciplinary group of experts working to develop new drugs and diagnostics for tropical diseases. Using state-of-the-art laboratories and equipment, the team at CDDR regularly works with industry, academia and other nongovernmental organizations to discover, develop and deliver novel therapies and diagnostics against a range of pathogens.

The team's experience includes drug discovery and development projects for malaria, tuberculosis and neglected tropical diseases. CDDR offers access to patient populations, and pathways to drug and diagnostic evaluation and implementation, in the UK, Africa, Asia and South America, as well as field sites for monitoring and evaluation in Africa, South America and South East Asia.

LSTM
CENTRE FOR DRUGS AND DIAGNOSTIC RESEARCH

2017-2018 has been an outstanding year for the Centre, with programmes in both therapeutics and diagnostics reaching significant developmental milestones. CDDR currently has two preclinical candidate molecules for the treatment of onchocerciasis (river blindness) and lymphatic filariasis (elephantiasis), which is a significant achievement for the Centre with Professors Steve Ward and Mark Taylor as PIs.

The first drug candidate is the first ever 'designer' Onchocerca macrofilaricide clinical candidate, known as ABBV-4083, which was selected from the tylosin analogue macrofilaricide (TylAMac) series, a partnership with AbbVie and Drugs for Neglected Diseases initiative. This drug candidate successfully progressed through formal preclinical toxicology testing and is now in first-into-man Phase I development to determine tolerability in health human volunteers.

The second candidate molecule developed in partnership with LSTM, University of Liverpool and Eisai Inc., is an anti-*Wolbachia* macrofilaricide from an azaquinolozine series.

The drug candidate known as AWZ1066, with the potential to mediate a 7 day or less drug cure for onchocerciasis, has recently received Medical Research Council (MRC) Development Pathway Funding (DPFS) of £1.5 million to progress the candidate to a point where it may enter clinical testing.

The CDDR's neglected tropical diseases (NTD) portfolio was further boosted by Dr Joe Turner's laboratory receiving extended funding from Bill & Melinda Gates Foundation in recognition of their important contributions to the Macrofilaricide Drug Accelerator Consortium. The consortium, consisting of multiple pharmaceutical and academic partners, is working toward selecting novel candidate drug cures for river blindness in 2019.

The CDDR anti-tuberculosis programme also received a fillip from the MRC DPFS, with Professor Biagini as PI, for a £1.25 million programme in partnership with the TB Alliance and the University of Liverpool, to investigate new combination therapy against multi-drug resistant (MDR) tuberculosis (TB). The programme will specifically look at inhibitors of the respiratory chain of Mycobacterium tuberculosis, the causative pathogen of TB, to validate this pathway for onward formal drug discovery programmes.

CDDR's therapeutic activities are not limited to small molecules but also include biologics and corrective treatment of diseases. In biologics, Dr Britta Urban's team have identified antibodies blocking adhesion of P. falciparum-infected erythrocytes to host endothelial receptors using analysis of single B cells. These antibodies can now be exploited for the development of adjunct therapy for the treatment of severe malaria and rational design of vaccines.

LSTM's Professor Steve Allen, working with Professor Carter of Edge Hill University, has initiated a NIHR Research for Patient Benefit-funded programme to assess the feasibility of dietary therapy for the initial treatment of Crohn's disease in children. The study involves the recruitment of 50 children with Crohn's disease at Liverpool's Alder Hey Hospital and will assess whether bovine colostrum, or "first milk" produced after calving, improves gut health and nutrition. Bovine colostrum is used extensively by elite athletes to improve performance and contains multiple anti-inflammatory, anti-infective and intestinal repair factors that may be of benefit in Crohn's. Pursuing the theme of the "global paediatric gut", evidence that First Milk reduces intestinal inflammation in Crohn's disease would encourage trials to improve gut integrity and function in severe malnutrition.

CDDR's activities also include disease transmission blocking activities and clinical pharmacology. LSTM's Professor Feiko ter Kuile and Dr Menno Smit have recently presented a clinical study undertaken in Kenya, focused on using Ivermectin as a mosquitocidal agent for interrupting malaria transmission. The work which was published in the Lancet Infectious Diseases journal earlier this year shows that mosquitoes that bite patients who have taken ivermectin live for a significantly shorter time than those who bite patients who have taken placebo. This deadly effect of ivermectin upon mosquitoes can last for up to a month from the patient taking it. Based on those results, epidemiological modelling shows that malaria transmission rates can be significantly reduced when ivermectin is administered to populations in endemic areas.

In the past year, the malaria team at MLW in Malawi led by Dr Anja Terlouw, continued to grow its capacity in clinical pharmacology research. Building on the EDCTP funded ADAPT, ADJusT and IMPACT projects and findings, a collaboration with the IMPROVE Consortium, led by Professor Feiko ter Kuile, will allow the MLW team to lead in two pharmacology sub-studies within the Consortium:

- Pharmacokinetics and cardiac safety of repeated dosing of dihydroartemisinin-piperaquine during intermittent preventive treatment of malaria in pregnancy among HIV infected women on antiretroviral therapy and HIV uninfected women in Malawi, with Dr Eva Maria Hodel as PI.
- Impact of standard antiretroviral therapy on the placental penetration of piperaquine among HIV infected and uninfected pregnant women in Malawi with Clifford Banda as PI.

The CDDR's pharmacology team was further boosted by the prestigious 3 year award of an MRC Skills Development Fellowship to Dr Ghaith Aljayyoussi, who will use novel pharmacometric approaches to identify and prioritise novel antimalarial combination therapies. This Fellowship will be supported by a collaboration with Dr Jeremy Burrows of the Medicine for Malaria Venture.


Dr Emily Adams

The CDDR diagnostic portfolio also saw significant achievement in the past year. It continued its record of work on improving leishmania diagnostics, led by Dr Emily Adams, with the commencement of a WHO-TDR funded project to embed diagnostic sand surveillance of Visceral Leishmaniasis into non-specialised VL centres in the health care system in India, in addition to working with Médecins Sans Frontières (MSF) to define the prevalence of asymptomatic visceral leishmaniasis infection in HIV positive patients in India, and risk factors for progression to symptomatic VL.

It also begun a study to identify a signature in exhaled breath to differentiate between viral and bacterial pneumonia, with patients recruited from NHS sites in Liverpool, Leicester and South Wales. This is important as such a test could help GPs and hospital doctors identify who needs antibiotics for respiratory tract infections, and who does not, sparing the use of antibiotics and potentially reducing the emergence of antimicrobial resistance (AMR). This project, led by Dr Emily Adams, is a partnership involving LSTM Clinical Sciences department, Warwick University, industrial partners and multiple NHS trusts.

The development of novel diagnostics for AMR has continued in the CDDR, led by Dr Thomas Edwards. A highly multiplexed qPCR assay for detecting important AMR markers in Gram-negative bacteria is currently being used to test drug resistant strains isolated from patients at the Royal Liverpool University Hospital, in order to describe the local epidemiology of AMR genes. After a promising evaluation of this assay, further funding has been acquired from the MRC to develop this assay into a kit with collaborators Biofortuna, with the aim of easing future commercialisation.

The diagnostics group is expanding its work on emerging and Viral Haemorrhagic Fevers led by Professor Luis Cuevas. Having developed in-house prototype assays for Chikungunya and Dengue, the Centre has secured further funding for the optimisation of these tests into multi-valent platforms, and the development of new molecular assays for Lassa fever and Crimean Congo Haemorrhagic Fever with industrial partners, Public Health England, the Nigerian centres for Disease Control and academic partners in Hamburg and Turkey.

Work continued on tuberculosis diagnostics, also led by Professor Luis Cuevas. This includes EDCTP and Stop TB Partnership funded studies in Nigeria and Ethiopia to evaluate triage tests for screening individuals with presumptive TB, evaluating new molecular platforms (e.g. TrueLab, Ultra), and media for the safe transport of sputum from remote locations. These studies have led to the development of new diagnostics algorithms for Low and Middle-Income Countries and the development of evidence for new diagnostics undertaking the process of endorsement for the World Health Organization.

CDDR continued its work as part of the COU**NTD**OWN consortium to improve surveillance of schistosomiasis and soil-transmitted helminthiasis. Dr Lucas Cunningham revisited Ghana to carry out further assessment of the use of the Global Polio Laboratory as a surveillance platform to improve the molecular diagnostic capabilities in-country. It is hoped that by utilising the GPLN to screen for schistosomiasis and soil-transmitted helminthiasis, that the question over the legacy of the GPLN, in a post-polio world, can be further explored. Work has also continued with regards to the expanded access to praziquantel trial around the Weija reservoir outside Accra, Ghana. The 12 month follow-up survey has recently been completed and the project is set to conclude in early 2019.

CDDR's Vera Unwin carried out the first evaluation of the new Alere Ultra-sensitive RDT for Pf malaria Asia. This test has promised to greatly improve the diagnosis of asymptomatic malaria, and malaria in pregnancy, and robust evaluation is urgently required by the global malaria community. Further evaluations in Kenya are planned during 2019.

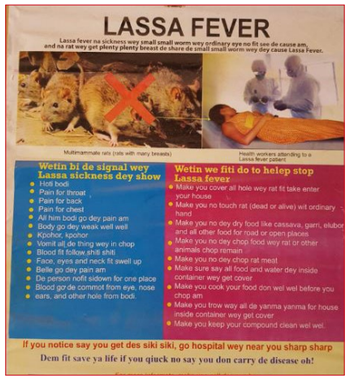
Department of Clinical Sciences

The department provides an excellent platform for translational research from concept through discovery and clinical trials to evidence synthesis, teaching, policy change and health impact. The department brings together staff working across the spectrum of clinical sciences. Some of the department's activities are highlighted elsewhere in this report, such as the Feature Article Lung Health and TB which includes the work on human models for vaccine immunology and the work addressing Lung Health and TB in Africa.

Professor Daniela Ferreira - Head of Clinical Sciences

Viral Haemorrhagic Fever

LSTM plays an important role in the response to public health emergencies, particularly with respect to elevating the importance of clinical management as an integral pillar of controlling outbreaks of viral haemorrhagic fever (VHF). Dr Shevin Jacob recently deployed, through WHO, to work in the Ebola outbreak in North Kivu, Democratic Republic of Congo. He was part of the WHO team providing guidance and oversight for the provision of investigational therapeutics, that to date (October 2018) has resulted in administration to over 100 patients.



Member of Sudan's MoH recruits a child into the Kassala study

In addition to Ebola Viral Disease (EVD), LSTM has been involved in forging new research collaborations in Lassa fever in Nigeria. Dr Tim O'Dempsey deployed under WHO to support Nigeria during a large Lassa fever outbreak. As part of the WHO Task force for Crimean-Congo Haemorrhagic Fever (CCHF) research and development, Dr Tom Fletcher focussed on developing a consortium with the Bernard Nocht Institute of Tropical Medicine to undertake phase 2 clinical trials in CCHF and Lassa fever, and jointly evaluate novel diagnostic platforms. Through partnership with the UK Public Health Rapid Support Team and Federal Ministry of Health of Sudan, Dr Fletcher also investigated VHF outbreaks from Darfur and recently deployed to Sudan's Kassala state to research an outbreak of undifferentiated febrile illness.

Paediatrics and Child Health

Professor Stephen Allen continues his work on improving nutrition in vulnerable newborns via the Neonatal Nutrition Network. This network links neonatal units in Nigeria and Kenya with UK researchers and clinicians. Using anonymised data of newborn admissions allows the Network to identify and develop proposals for research and supporting improvements in clinical care. It also undertakes a systematic review of the evidence base and a survey of feeding practices for low birthweight newborns in both countries. In the UK, at Liverpool's Alder Hey Children's hospital, two research studies of gut health in children are being funded through the NIHR Research for Patient Benefit programme.

African Research Collaboration on Sepsis (ARCS)

ARCS is a newly formed NIHR Global Health Research Group at LSTM. This £2m initiative aims to improve the quality of care for patients with acute severe infection (sepsis). There has been a huge investment in sepsis care in the UK over the last few years. This reflects that it has been previously under-recognised and that urgent treatment can save lives. Such investment has not been seen in Low and Middle Income Countries (LMIC), although the burden of sepsis disease is thought to be higher. The WHO's 17th World Health Assembly resolution on Sepsis last year has focussed attention on this neglected area. ARCS is excellently placed to capitalise on this. Through investment in its 3 centres of sepsis-research excellence in sub-Saharan Africa (Malawi, Uganda, Gabon), ARCS will build research skills and expertise, and maximise cross-learning from successful quality improvement programmes in the UK's National Health Service.

The group is supported by representatives from WHO, the Global Sepsis Alliance, and Ministries of Health, and has includes world-class specialists in Health Systems Research (W-CAHRD), social science, radiology, and policy implementation, alongside experienced in-country researchers.

ARC's kick-off meeting in September 2018 demonstrated the power of cross-disciplinary approaches as it established broad consultation on what quality means to patients in LMIC and agreed a pathway to further develop and test the pilot interventions.

School children on the way to school in Narok, Kenya

Menstrual Health

In Kisumu, Kenya, Dr Phillips-Howard and team are collaborating with the Kenya Medical Research Institute (KEMRI), where they are conducting a randomised controlled trial among ~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. In addition, they have initiated a sub-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. They are also collaborating with KEMRI on an impact evaluation on the effect of DREAMS interventions on adolescent girls and young women risk of HIV acquisition in western Kenya.

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 (see feature article on malaria). Six PhD students are enrolled as part of these studies.

Tropical Clinical Trials Unit (tCTU)

The unit supports high quality clinical trials to test interventions aiming to reduce the disease burden of low and middle-income countries with studies on HIV, malaria, tuberculosis, respiratory infections, non-communicable diseases and reproductive health. Over the past year staff has joined including a trial manager, statisticians, data managers and a pharmacovigilance officer to monitor side effects of trials. Staff visited multiple sites to gain familiarity with the trials and local work environment. The unit will further expand with new projects and staff in 2019. The unit works with partners to establish systems to deliver high quality research within a Good Clinical Practice envelope, ensuring good quality data and outputs. Good working relationships with Research Units at MLW and KEMRI ensure improved working practices and cross-party implementation.

Health Economics

LSTM Health Economics, led by Professor Louis Niessen, run collaborations across departments and with partner institutions in Bangladesh, Kenya, Malawi, Ghana and Cameroon. High-impact studies on the chronic disease epidemics in low-income countries and related intervention studies have been published. Studies were completed on malaria and household impact as well as the socio-economic impact of the control of neglected diseases. *See also Feature Article on Applied Health.*

FEATURE ARTICLE

Lung Health & TB

LSTM's research covers the full spectrum of the complex, often poverty driven, global problems around chronic lung diseases, respiratory infection and tuberculosis (TB). It aims to reduce infection, improve prevention and optimise treatments.

The International Multidisciplinary Programme to Address Lung Health and TB in Africa (IMPALA), led by Professors Squire and Mortimer as well as Dr Angela Obasi, is one of the 13 Global Health Research Units funded by the National Institute for Health Research (NIHR). Its overall aim is to improve the health of children and adults in Africa through multi-disciplinary applied health research on lung health and tuberculosis.

IMPALA team

Launching its 2nd year at the Annual Programme meeting in Durban in April 2018, IMPALA is a multidisciplinary programme that brings together scientists from the disciplines of clinical sciences and public health, social sciences, health systems, health economics, and policy research from 22 institutions, 16 of which are in 10 African countries. The year has seen major progress in its strategic aims of research excellence, policy engagement and capacity development.

Two of its major studies - a large clinical and health economics birth cohort in Uganda and cross- country health systems and community engagement project in Sudan and Tanzania - are in the final preparatory phases. The first will deliver unique evidence of the impact of food insecurity, mother's dietary diversity and in-house air pollution on infant's lung health. The second will explore the requirements and process for developing context appropriate integrated lung health services in LMICs, drawing on action research in Tanzania and Sudan. In line with IMPALA's commitment to building capacity in lung health research among African researchers, these projects are led by African early career researchers.

IMPALA awarded five PhD studentships to African candidates. Four of these included an MRes foundation year, which is nearing completion and they are now turning their attention to their substantive projects. These range from innovation in emergency diagnosis to generating new knowledge about the economic and social burden of lung disease.

Two of these students Brenda Mungai and Irene Ayakaka, have been central to IMPALA's contribution in the battle to ensure that research evidence is translated into policy in the UK and internationally. After policy engagement activity by the IMPALA team and others, in June 2018, Dame Louise Ellman DBE MP addressed a House of Commons backbench business committee debate on ending tuberculosis, in which she cited the IMPALA programme. Later that month, Irene Ayakaka represented IMPALA at the Civil Society Hearing on TB at the United Nations. The focus of her speech on applied health research contributed to recognition of the importance of applied health research in the text of the Political Declaration on TB. This was endorsed at the UN General Assembly High-Level Meeting on TB in September. This meeting of global heads of state was of seminal importance. The Declaration will provide the global framework within which TB control will be advanced

IMPALA PhD student Brenda Mungai with Professor Abubakar, Chair of WHO Strategic Technical Advisory Group on TB, at UN High Level Meeting on TB

until 2030. This was the first time that TB has been discussed in the UN General Assembly, in recognition that TB now kills more people around the world than any other infectious disease. IMPALA's participation in the High-Level Meeting provided important lessons on engagement with international policy formulation.

IMPALA also works towards raising the profile of lung health and TB locally and on September 25th the team marked World Lung Health Day by installing giant inflatable lungs outside the new Accelerator building. Project staff engaged with passers-by throughout the day, together with colleagues from LSTM, the Royal Liverpool University Hospitals Trust and Roy Castle Foundation.

IMPALA has led or supported a substantial range of capacity building activities in Africa through multi-disciplinary courses such as Spirometry and Air Quality training (7 spirometry training sessions across Africa) and the PATS MECOR course which ran concurrently with the IMPALA annual meeting. Over 40 students graduated from PATS MECOR in 2018 building capacity for clinical and epidemiological research in lung health in Africa.

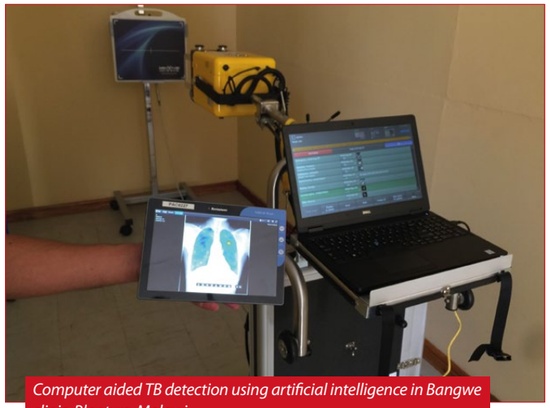
Developing capacity for multidisciplinary working has its own focus within IMPALA and Dr Yan Ding has commenced data collection to provide learning how this important area can be enhanced in global health research.

Other IMPALA outputs were securing £9.5 million in funding from the MRC, NIHR and the Wellcome Trust; publishing 9 papers and 29 conference abstracts. IMPALA researchers contributed to the biennial Health Systems Global Symposium in Liverpool. These included panel sessions on Community Health Worker quality; self-care and self-diagnosis; improving health systems responses to chronic disease and disability; an oral presentation on social science research into improved cookstove use in Malawi and a Photovoice exhibition, showcasing global insights from participatory photography. IMPALA attended The Union World Conference on Lung Health in The Hague where they presented abstracts and engaged with the public at their interactive stand.

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 have combined to drive extremely 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).

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 clinic with cough will be rapidly screened for TB using high-throughput digital chest X-ray. Thorough carefully monitoring 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.


Computer aided TB detection using artificial intelligence in Bangwe clinic, Blantyre, Malawi

The PROSPECT Study will investigate 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.

Results of the PROSPECT Study will be of high importance to policymakers. The MLW International Scientific Advisory Board highlighted TB computer-aided diagnosis as one area where Malawi research and implementation are accelerating ahead of what is available in high-income countries. A recent visit by a science journalist from the Wellcome Trust highlighted the potential transformative nature of optimised TB diagnosis systems in Africa.

IMPACT TB

IMPACT TB, led by LSTM's Dr Maxine Caws and funded by the European Union, is implementing and evaluating alternative case finding strategies for TB in communities of Nepal and Vietnam. The consortium, which includes Karolinska Institute (Sweden) and KNCV (Netherlands), aims to provide evidence to support policy decisions by National Tuberculosis Programmes on practical strategies to reduce TB in low and middle-income countries.

Active case finding has been under way for one year in six districts of Ho Chi Minh City Vietnam and four districts of Nepal, with over 1,000 extra TB cases diagnosed and treated.

A community awareness event organised by IMPACT TB in Makwanpur district, Nepal, on World TB Day (24 March)

The impact of active case finding on patient costs has been assessed and the findings will be published soon. The consortium has been joined by Johns Hopkins University funded by TB-MAC. Dr Tom Wingfield has also started pilot work on socioeconomic support models funded by the Wellcome Trust. In Nepal a project has been developed with Stony Brook University to test drones for sample transport in remote rural districts, funded by the Simmons Foundation, which will be 'taking off' in 2019.

Breathspec

LSTM's Dr Nick Feasey, Dr Andrea Collins, Dr Emily Adams, Kelly Byrne and Paula Davies are coordinating the recruitment of over 1,300 participants over an 8-month period at 4 sites across Liverpool, from a study total of 2,000. In this observational pilot study, the device being used is an exhaled breath device by IMSPEX Diagnostics. The study will recruit patients with symptoms suggestive of a respiratory tract infection. The study aims to identify biomarkers (volatile organic compounds) in exhaled breath to be able to differentiate between a bacterial and non-bacterial respiratory tract 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 four Liverpool sites are the Royal and Aintree Hospitals in secondary care and Princes Park and Brownlow GP practices as primary care sites. Other sites include the Royal Glamorgan Hospital, Warwick and Leicester. The study is funded by Horizon 2020.

Pneumonia Vaccine Research

The Respiratory Infection and Vaccine group, led by Professor Daniela Ferreira, has had a successful year, conducting pioneering research to develop better vaccines against pneumonia. The team works in partnership with the NHS, CLRN, CEIDR, life sciences industry partners and academic collaborators worldwide. The group developed and runs the only pneumococcal human challenge model worldwide. This model involves exposing volunteers to pneumococcal bacteria by nasal inoculation to mimic natural acquisition of pneumococcus resulting in nasal carriage. This unique model allows the examination of natural pneumococcal immune responses and the findings can help to develop better pneumococcal vaccines in the future.

This Experimental Human Pneumococcal Challenge (EHPC) model has been effectively running for nearly 10 years now. During this time > 1200 volunteers have been inoculated; including healthy volunteers, asthmatics and over 50's. Results have shown that small numbers of pneumococcal bacteria in the nose could help protect people against subsequent disease. This model has also been used to test vaccine effectiveness to prevent nasal colonisation, which is thought to be a pre-requisite for pneumococcal disease.

Opening of the Accelerator Research Clinic (ARC)

The group was proud to announce the opening of their own, state of the art, research clinic following a charitable donation of £40,000 from Unilever. The clinic was opened earlier this year and the group already completed a large randomised control trial in this new facility.

The Accelerator Research Clinic (ARC), within the new Liverpool Life Sciences Accelerator building, will allow further growth of the group. The clinic is managed by Dr Andrea Collins, Senior Clinical Lecturer and Respiratory Consultant (ARC Director), and Sister Angela Hyder-Wright, Senior Research Nurse (ARC Manager).

Understanding Host Susceptibility

This year the team completed trials investigating pneumococcal colonisation in groups who are more susceptible to pneumonia and pneumococcal disease. Funded by a MRC Programme grant, the team have investigated pneumococcal colonisation and immune responses in asthmatics taking inhaled steroids and in the over 50's. These studies have given a new insight into susceptibility to pneumococcal disease whilst provides vital information relevant to vaccine development. The group is now running a further healthy participant study with an attenuated pneumococcal strain and in patients with COPD and smokers as part of an MRC programme grant in the ARC. It also conducts a large research bronchoscopy study with the Clinical Research Unit at the Royal Liverpool Hospital.

Commercial Partnerships

With support from Unilever since 2017, the team completed a pilot study looking at the feasibility of modifying the EHPC model to investigation transmission of pneumococcal bacteria from the hands to the nose. And a large randomised control trial this year. This study investigated the effectiveness of washing hands with antibacterial soap on reducing the transmission of pneumococcus.

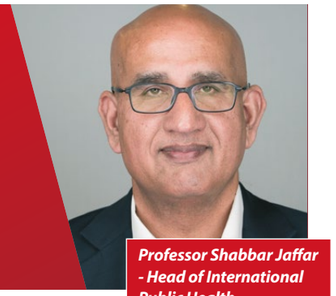
Working Together Across Liverpool

The team has been working with Alder Hey Children's Hospital to look at children who naturally carry pneumococcus in the nose. This study has been able to translate the team's findings from studying adults to children who are a target group for many pneumococcal vaccinations. It is led by Dr Simon Jochems and funded by LSTM's Director's Catalyst Fund.

The team have also been working with Ear, Nose and Throat Surgeons at Aintree University Hospital and Royal Liverpool Hospital to collect larger samples of tissue from the nose and throat of volunteers.

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 focus particularly on health systems research and its use in guiding policy and programming in order to strengthen health systems and improve care.



Professor Shabbar Jaffar - Head of International Public Health

HIV-infection in Africa

Dr Chelsea Morroni, a Reader in International Sexual and Reproductive Health, joined LSTM in November last year. She is the Director of the Botswana Sexual and Reproductive Health Research Initiative, currently leading research and policy work on contraceptive care in the context of HIV. She is also the Deputy Director of the UK Faculty of Sexual and Reproductive Health's Clinical Effectiveness Unit.

Professor Frances Cowan is the Director of The Centre for Sexual Health and HIV AIDS Research Zimbabwe (CeSHHAR). She is leading extensive large-scale studies of prevention of HIV-infection in Zimbabwe, with a particular focus on key populations including sex-workers and adolescents. She leads Zimbabwe's national programme for female sex workers on behalf of the National AIDS Council. In addition, she is conducting an evaluation of the Zimbabwe government's national elimination of mother to child transmission programme. Alongside Dr Miriam Taegtmeyer, Professor Cowan is a partner in the large consortium evaluating the expansion of HIV self- testing in Africa – a potential game changer in the field. Dr Euphemia Sibanda, a social scientist and epidemiologist with CeSHHAR, won the prestigious MRC African leaders award under Professor Cowan's guidance. Both Dr Sibanda and Dr Webster Mavhu, another project lead within CeSHHAR, will shortly be joining LSTM.

Professor Jaffar's work, together with colleagues at St Georges University of London, on the management of cryptococcal meningitis was published in the New England Journal of Medicine in March 2018 and led to new guidelines issued by the World Health Organization.

Funded by NIHR and Horizon2020 and together with LSTM colleagues Dr Anupam Garrib, Professor Louis Niessen, Dr Tinevimbo Shiri, and African and European partners, Professor Jaffar has now started a long-term research programme evaluating models of integration of services for HIV-infection, diabetes and hypertension.

Centre for Maternal & Newborn Health (CMNH)

CMNH is an internationally recognized Centre of Excellence conducting research, teaching and technical assistance. The Centre is a WHO Collaborating Centre, member of the global Maternal and Perinatal Death Surveillance Response Technical Working Group and sits on various expert advisory panels; it works with UNICEF through a Long Term Agreement to provide expertise on Quality Improvement and Evaluations in Maternal & Newborn Health; with The Global Fund to improve the availability and quality of integrated HIV, TB and malaria services delivered to mothers and newborns in facilities providing antenatal and postnatal care and the European Commission on burden of diseases in infants potentially preventable by maternal immunization in collaboration with Professor Cowan's team in CeSHHAR. The team has over 75 staff and research programmes across Asia and Africa. *See for more info Feature Article on Maternal, Newborn and Child Health.*

Capacity Research Unit

CHW in Sierra Leone present photovoice images

The Capacity Research Unit (CRU) at LSTM specialises in the science of research capacity strengthening – a process of individual and institutional development leading to higher levels of skills and greater ability to perform useful research. CRU has seen a rapid expansion in activities with 10 new grants awarded for research across Africa, and the recruitment of 8 new members of staff. *See for more info Feature Article on Applied Health.*

Health Systems & Workforce Strengthening Unit

The unit leads the DFID-funded ReBUILD consortium which is in its eighth and final year. Under Dr Jo Raven's leadership the unit also completed the RECAP-SL project. The PERFORM2Scale consortium is now at full implementation stage. Dr Raven gained a place on LSTM's competitive career track programme. Led by Dr Miriam Taegtmeyer, the community health systems group continues to research the interface between communities and health systems, shining a spotlight on the quality of care provided by community health workers. In Kenya the SQALE project has developed a robust model adapting and integrating quality improvement approaches to the community health strategy, creating community-facility linked work improvement teams – an approach that has been taken up by national and county policy. Work on self-care and HIV self-testing as part of the STAR Initiative in Southern Africa shows how innovative approaches to diagnosis and care can increase equity of services and support universal health coverage.

Monitoring, Evaluation, Training and Research (METRe)

METRe, led by Professor Joseph Valadez, is a leading unit for M&E, operations and implementation research. During last year, METRe helped governments to strengthen their health system informatics, carry out nationwide assessments of the quality of care and support the roll-out of rapid M&E methods. It has developed a series of open access videos and survey tools which can be accessed at its website.

National household survey data collectors' training, using Lot Quality Assurance Sampling, Jonglei, South Sudan

ReBUILD

With a large proportion of the world's extreme poor living in conflict-affected situations projected to rise to more than 60% by 2030, these populations represent some of the most 'left behind'. It is clear that the Sustainable Development Goals (SDGs) cannot be achieved without a focus on the needs of the millions of people currently living in these fragile states. When ReBUILD was planned in 2009 this was a largely unresearched area, and the aim of the DFID-funded consortium was to learn lessons from conflict and crisis-affected states about how best to re-instate stronger and more resilient health systems that would address the needs of the whole population.

Mothers waiting for their babies to be vaccinated at a primary health care clinic in Zimbabwe

ReBUILD partners, led by LSTM, put together a team of researchers with expertise in human resources, financing and gender in the conflict and crisis-affected countries of Cambodia, Sierra Leone, Uganda and Zimbabwe. Working with affiliates it was able to extend its reach other countries and regions such as Timor Leste. ReBUILD's research covered a range of areas including human resources (recruitment, deployment and incentives, the use of community health workers and the gendered nature of the workforce); financing of health care and the impact on access for vulnerable populations. The consortium has published numerous peer reviewed papers and looked at other ways to ensure research impact, while ReBUILD's partners engaged to inform relevant policy processes in study countries. Yet the key strength of the programme's research has been through application of cross-cutting research analyses from different post-conflict settings to inform policy and practice in current conflict and crisis settings. During the Ebola outbreak in Sierra Leone, ReBUILD worked with the Ministry of Health and Sanitation, the WHO and others, to support the continued delivery of essential programmes by the health workforce through the epidemic, and subsequently in developing the National Recovery Strategy and the Sierra Leone Human Resources for Health Strategy 2017-2021.

ReBUILD's researchers worked directly with the Global Fund to help develop its Strategy for Challenging Operating Environments and with the WHO to develop guidance on health financing in FCAS. Researchers engaged with policy actors on gender, fragility and health systems in international meetings and have helped coordinate and actively fed into the call for evidence from the Global Health Workforce Network Gender Equity Hub. ReBUILD's work is currently informing approaches in settings of conflict and crisis, playing a leading part, with partners, in an official side event at the 71st World Health Assembly, sponsored by the governments of Switzerland and Afghanistan. This has led to a Call to Action for UHC in Emergencies, launched by the Swiss President in September 2018 at the UN General Assembly. This phase of the eight-year ReBUILD programme is due to end in early 2019.

FEATURE ARTICLE

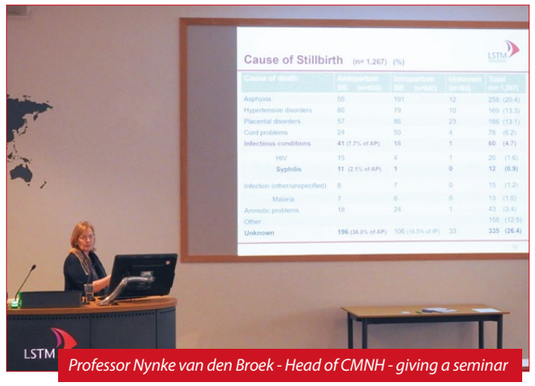
Maternal and Newborn Health

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

Maternal and Newborn Health

Every year, 303,000 women die due to complications during pregnancy and childbirth, 2.6

million babies are stillborn, and 2.7 million newborn babies die. Most of these deaths can be prevented if effective, good quality care is available. The Centre for Maternal and Newborn Health (CMNH) at LSTM is passionate about ending these preventable deaths and improving the health of mothers and babies.



Professor Nynke van den Broek - Head of CMNH - giving a seminar

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 methods, the use of data, and, it develops new indicators and frameworks to evaluate the effectiveness of single or complex interventions.

CMNH developed its new strategic plan and between 2018 and 2023 its strategic objectives are to:

- Grow as a global leader in implementation research
- Discover and develop evidence-based, scale-able methodologies and approaches to improve the availability and quality of healthcare for mothers and babies during and after pregnancy such that this meets the identified health needs of mothers and babies, results in improved health outcomes, and, a positive experience of that care
- Ensure that new knowledge and evidence generated is shared, used to inform policy and practice, and, informs the global agenda for maternal and newborn health
- Expand and develop our partnerships with governments, research institutions and global agencies to implement effective sustainable healthcare interventions and programmes
- Ensure CMNH has a 'first class' operating environment, and, is the 'go to' partner for implementation research in maternal and newborn health

Throughout 2018 CMNH worked in partnership with 36 partners across 17 countries in sub-Saharan Africa and Asia. Its portfolio includes 18 live programmes, with grants from 10 donors totalling more than £15 million.

Antenatal and Postnatal Care (ANC and PNC)

Globally, 83% of women attend for an antenatal care visit (ANC) on at least one occasion during pregnancy and 64% attend four times or more. In practice, however, such visits constitute a series of 'missed opportunities' for the identification and management of health needs of not just the mother but also the wider family. Additionally, although most neonatal deaths occur in the first week after birth, only 48% of women and babies receive postnatal care (PNC).

In the past year, CMNH has designed and implemented a number of innovative intervention packages and measurements to guide a renewed focus on ANC and PNC in low- and middle-income countries. These include:

- New tools to measure the burden of physical, social and psychological maternal morbidity during and after pregnancy. These have been used to measure burden of disease in Kenya, Malawi, Pakistan and India.
- A new 5-day competency-based ANC and PNC workshop package for healthcare providers to identify and manage the health needs of mothers and babies during and after pregnancy with integration of care across three main diseases: HIV, TB and malaria. This training package has been introduced in Afghanistan, Ghana, Togo and Chad, with plans for further roll out in 2019.
- Multi-country surveys to assess the availability, content and quality of ANC and PNC in Afghanistan, Togo, Ghana, Chad and Niger.
- New protocols for robust implementation research including using step-wedge design trial approaches to generate evidence for the effectiveness of ANC and PNC with regard to improving health outcomes. These will be conducted across several countries from 2019.

Skilled Birth Attendance (SBA)

To reduce maternal mortality, it is important that all women have access to professional skilled attendance at birth (SBA). CMNH has conducted studies to explore the scope of practice, factors that enable or hinder healthcare workers providing SBA and solutions to providing an enabling environment. It completed a multi-country study to assess the contribution of Community-based Health Workers in providing care during and after pregnancy and at the time of birth, in sub-Saharan Africa and Southeast Asia. This year, CMNH and the Foundation for Research in Community Health (FRCH) have continued to work together on a programme to improve the quality of care provided by Auxiliary Nurse Midwives (ANMs) in India.

Emergency Obstetric Care (EmOC)

Emergency Obstetric and Newborn Care (EmOC) is an evidence-based care package designed to save lives and reduce preventable stillbirths, maternal and neonatal mortality and morbidity. CMNH's 'skills and drills' workshop package is accredited by the World Health Organization (WHO) and the Royal College of Obstetricians and Gynaecologists (RCOG) and has been used to train over 30,000 healthcare providers in 20 countries. In 2018, this included Kenya, Tanzania, Nigeria, Malawi, Sierra Leone and Cambodia.

In the past year, a new complementary five-day workshop package for extended EmOC&NC was developed to improve the quality of care provided to women undergoing caesarean section, vacuum delivery or forceps. This new training package is aimed at healthcare providers who deliver obstetric surgery, including theatre and maternity staff, anaesthetists, surgeons, medical officers and peri-operative nurses. It was piloted in Cambodia with support from GIZ, and, was delivered in Nigeria with support from Johnson & Johnson.

Newborn Care (NC)

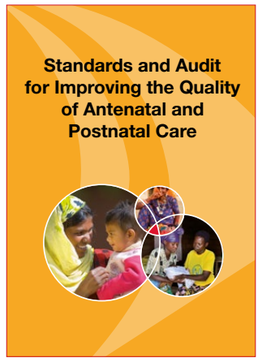
Skills training in examination of the newborn

Neonatal mortality accounts for 45% of all under-5 child mortality. This year, CMNH was commissioned by UNICEF-Bangladesh to conduct a performance assessment of UNICEF-supported Special Care Newborn Units (SCANUs). This study will assess how SCANUs operate, including how they integrate with newborn care services at other levels of the healthcare system and with maternity units. It will also identify facilitators and barriers to the running and expansion of SCANUs to inform further scale-up across the country.

A population-based prospective cohort study is ongoing in Ghana and Zimbabwe to assess the burden of neonatal and child diseases potentially preventable by maternal immunisation. This study, funded by the European Commission, will focus on will focus on Group B streptococcus (GBS), Respiratory Syncitial Virus (RSV), Influenza and Pertussis (GRIP). Findings will be used to develop recommendations for the prioritisation of vaccines, inform the investment case for vaccines for GRIP organisms and initiate discussions with appropriate stakeholders on ways to make maternal immunisation accessible to these populations.

Quality of Care

Quality improvement is a critical component of CMNH's work in many countries. In 2018, CMNH completed the first national survey to assess the availability and quality of care provided across all levels of healthcare facilities in Niger. In just under six weeks, ten teams visited 110 healthcare facilities in all eight regions of the country. They collected data from healthcare facility registers and records, through interviews and group discussions and via observation of practice during the visits. Overall, they spoke to over 2,600 people (1,595 pregnant women and mothers, 914 healthcare providers and 110 managers), observed 461 consultations and analysed nearly 950 care records. This data will be used to develop a new action plan for Niger to improve the availability and quality of maternity care.



CMNH developed and published new manuals for improving the quality of ANC and PNC which outline the essential steps needed to conduct standards-based audit. The manuals set out internationally agreed standards for care, including women- and baby-friendly care, organisation of ANC, management of obstetric complications, PNC for both mother and baby and management and/or prevention of malaria, TB, HIV and other infections. Each standard has a clearly stated and measurable objective as well as criteria for what resources will be required to achieve the standards, what actions will be needed and the expected results. The manuals were developed, translated and printed with support from the Global Fund to Fight AIDS, Tuberculosis and Malaria.

In February 2018, the first Confidential Enquiry into Maternal Deaths (CEMD) Review in Kenya was launched. With funding from DFID Kenya, CMNH experts supported the Ministry of Health, Kenya, to carry out this enquiry and to set up a National Maternal and Perinatal Death Surveillance and Response (MPDSR) Committee and establish a National MPDSR secretariat. Recommendations for priority action following this report have been agreed and will be used to develop policies to improve the quality of care for women. The CEMD will be repeated annually with CMNH support.

B!RTH

CMNH continued as scientific partner for the B!RTH programme, funded by Oglesby Charitable Trust. B!RTH uses the power of theatre and scientific debate to highlight the issues and solutions surrounding global inequality in the availability and quality of care for women before, during and at the time of giving birth. Over the past year, the plays have been performed at the World Health Organization, Geneva and several UK universities, including LSTM itself and Liverpool John Moores University. An event at the Wellcome Collection in London saw two of the plays performed in front of an invited audience. This was followed by a panel debate and Q&A with the audience, moderated by Channel Four News reporter Fatima Manji, in which the head of CMNH, Professor Nynke van den Broek, participated. The play from Syria, Q&Q, was also featured on BBC World Service Radio's cultural Frontline, with the play being adapted for the show in December 2017, followed by an interview with the playwright.

Now in its third year the plays have been performed during 11 events; 13 universities are using them for various courses and the plays have been downloaded 291 times from the website birthdebate.com

BIRTH debate panel

Paediatrics and Child Health

Supported by a MRC Confidence in Global Nutrition and Health Research Initiative Institutional pump-priming grant, the interest in gut health is focussing on improving nutrition in vulnerable newborns. The Neonatal Nutrition Network (NeoNuNet) links together 5 neonatal units in Nigeria and 2 in Kenya with UK researchers and leading NHS clinicians who have not previously engaged in LMICs. The core activity is contributing anonymised data of newborn admissions to a central database held at LSTM. Regular data summaries allow the Network to identify and develop proposals for research as well as supporting improvements in clinical care by sharing experience and expertise. The network is also undertaking a systematic review of the evidence base and a survey of feeding practices for low birthweight newborns in Nigeria and Kenya. The project was launched earlier this year during workshops in Ibadan, Nigeria, and Kisumu, Kenya, and progress will be reviewed in a workshop at LSTM late 2018. NeoNuNet has already facilitated a research proposal of maternal nutritional supplements in improving newborn health.

At Liverpool's Alder Hey Children's hospital, two research studies of gut health in children are being funded through the NIHR Research for Patient Benefit programme. Recruitment to the multicentre study assessing faecal volatile organic compounds (VOCs) in the diagnosis of inflammatory bowel disease has reached the midway point. Insights into the pathogenesis of paediatric inflammatory bowel disease provided by the VOCs profiles will be boosted by analysis of faecal fungi supported by additional funding from CORE secured by the University of Liverpool. Recruitment to the feasibility study of "first milk" (bovine colostrum) to improve gut health and nutrition in paediatric Crohn's disease will start in October. These two studies are supporting a PhD for Dr Salma Belnour, a previous MSc Tropical Paediatrics student. LSTM is also working colleagues from Edge Hill University to assess perceptions of dietary therapy and its acceptability and, in a study funded by Crohn's and Colitis UK, social isolation in young people with inflammatory bowel disease: "Being Me with IBD".

NeoNuNet collaborators visiting Jaramogi Oginga Odinga Teaching and Referral Hospital, Kisumu, Kenya

Malaria in Pregnancy

This year the team completed the first large-scale malaria chemoprevention trial with dihydroartemisinin-piperaquine in south-east Asia, led by Dr Rukhsana Ahmed, and funded by the MRC/DFID/Wellcome Trust Joint Global Health Trials Scheme. Results showed that monthly intermittent preventive therapy with dihydroartemisinin-piperaquine in the second and third trimester of pregnancy is a promising alternative to current policy of screening at first antenatal visit in areas of moderate-to-high transmission in the Asia-Pacific region. A pilot implementation of the intervention in Papua is now being considered by the Indonesian Ministry of Health. Phase-IV pharmacovigilance studies funded by Medicines for Malaria Venture (MMV) to further assess the safety of the artemisinin-based combination dihydroartemisinin-piperaquine in women in the first trimester are also ongoing.

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. The study has helped to inform WHO's policy on the use of sulphadoxine-pyrimethamine for the use of IPT in pregnant women. Similarly, the team lead a large study, involving other research groups world-wide, on the safety of artemisinin-based combination therapies (ACTs) in the first trimester of pregnancy. Results are currently under consideration by WHO.

The IMPPACT project, led by Dr Jenny Hill, supports the uptake of evidence on malaria in pregnancy (MiP) in country level policies and guidelines. Two regional meetings held in collaboration with the Roll Back Malaria (RBM) Partnership and the West Africa Health Organisation (WAHO) were held to disseminate the MiP Consortium's results generated by over 40 partners to 21 countries in sub-Saharan Africa. Policy research to explore the drivers of policy adoption at the national level to inform the translation of this evidence into practice will conclude in 2018.

Professor Ter Kuile and Dr Jenny Hill are now leading the new IMPROVE Consortium funded by the MRC/DFID/ Wellcome Trust and EDCTP to conduct two multicentre chemoprevention trials for the control of malaria, sexually transmitted and reproductive tract infections in HIV-infected and -uninfected pregnant women in Kenya, Malawi and Tanzania. Additional sub-studies on acceptability, feasibility and cost-effectiveness will be conducted alongside the trials.

Strategic & Clinical Partnerships

Malawi Liverpool Wellcome (MLW) Clinical Research Programme

The MLW Programme has had an outstanding year, with growth in both size and scale. There are now 14 Research Groups, 653 staff, and collaborations across the region. The next steps include improved clinical facilities, focused clinical and research postgraduate training, early phase clinical trials, research networks and strong African leadership.

Malawi-Liverpool-Wellcome Clinical Research Programme

Renewal of the MoU until 2023

MoU signatories Dame Janet Beer (UoL), Principal Dr Mipando (CoM) and Prof Hemingway (LSTM)

Director of MLW, Professor Stephen Gordon, was delighted to host the renewal of the MLW partnership at MLW's Annual Scientific Meeting in Chester. At the event, Janet Hemingway reflected on the progress MLW has made over the last 15 years, as she hands the partnership over to Professor David Lalloo for the next phase. Vice-Chancellor of the University of Liverpool, Professor Dame Janet Beer, and Dr Mwapatsa Mipando, Principal of the Malawian College of Medicine, emphasised the importance of the partnership for Liverpool and Malawi. For example many leaders in the College of Medicine (CoM) hold Liverpool degrees.

Deputy Director and Associate Director

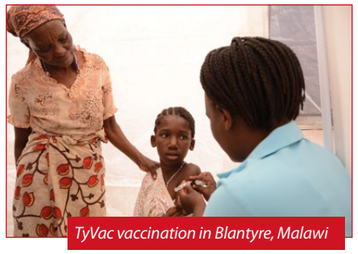
Dr Musaya - Associate Director MLW

Dr Mwandumba - Deputy Director MLW

Dr Henry Mwandumba was appointed Deputy Director at MLW this year and Dr Janelisa Musaya as Associate Director. Dr Mwandumba leads Immunology at MLW, as well as clinical HIV studies. He is President of the Federation of African Immunology Societies and led the MLW delegation to the Gates Grand Challenge meeting in Berlin. Dr Musaya leads for Neglected Tropical Diseases and Antimicrobial Resistance at the College of Medicine and the Quality Improvement in Publication (QUIP) project at MLW.

Major clinical trials

The Clinical Research Support Unit and several research groups have delivered large clinical trials this year. Most spectacularly, the conjugate typhoid vaccine trial (TyVac) vaccinated over 28,000 children over 6 months and is now in the active follow-up phase of that study. An early phase study of anti-cryptosporidial treatment in HIV-infected adults with chronic diarrhoea (Cryptofaz) demonstrated the potential of this treatment. The study of antibacterial medication in childhood diarrhoea (ABCD study) and a novel rotavirus vaccine study are all on target. It is probable that the study of malaria vaccine implementation (RTS,S) will start in 2019. A major trial of early effective TB diagnosis by mobile digital chest X-rays has just started led by Dr Peter MacPherson.



TyVac vaccination in Blantyre, Malawi

Controlled human infection models (CHIM)

MLW will build on LSTM's strength in CHIM research with a recently awarded major Wellcome Trust grant (£4.4m). The Malawi Accelerated Research in Vaccines by Experimental and Laboratory Systems (MARVELS) programme will determine how pneumococcal vaccination can be improved as they are not as effective in Malawi as in other regions with lower infection rates.

Clinical refurbishment and hospital infrastructure projects

Expertise and strengths in respiratory medicine at LSTM will allow a partnership with Queen Elizabeth Central Hospital to develop a Respiratory Medicine ward, High Dependency Unit and adult research ward. This project will include staff development, infrastructure improvement including the provision of oxygen, studies of sepsis and CHIM studies. Eventually, MLW aims to develop phase 1 and phase 2 drug trial capacity, linking with the discovery programmes at LSTM.

HIV self-testing and Liverpool FC

In an innovative project developed by LSTM, coaching staff of Liverpool Football Club came to Malawi to support MLW in promoting HIV self-testing among young men. Over 5000 young people attended the LFC coaching events and competitions. HIV self-testing offers a means for early diagnosis and entry to care for young people. This approach has been presented world-wide and has changed policy in Switzerland as well as Malawi.

Research networks

As MLW grows, it can lead in consortia and participate in research networks. Antimicrobial resistance is the focus of the Drivers of Resistance in Uganda and Malawi (DRUM) consortium led by Dr Nick Feasey. Patient outcomes in severe infection are the focus of the African Research Collaboration in Sepsis led by Drs Rylance and Jacob, especially in Malawi, Uganda and Gabon.

The CREATOR project

MLW has 2 central aims - to conduct research for health benefit and train the next generation of researchers. The Clinical Research Excellence and Training Open Resource (CREATOR) building will house innovative clinical postgraduate training facilities, a research resource centre, new research groups, new laboratories and take MLW to new heights. This is possible only through committed funding from the Wellcome Trust, LSTM and the University of Liverpool. Plans are at an advanced stage and building will start in 2019.

Visiting MLW

MLW hosts more than 30 visitors per month, with visits being arranged through one of the Research Groups. Visitors have the opportunity to give a seminar, present a workshop, or hear students present project progress and visit field sites with project teams. Visitors can also join the clinical teams on ward rounds and tour the laboratories.

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

MLW is supported by WTCGHR, one of five Wellcome Trust Centres for Global Health Research.

LIVERPOOL · GLASGOW · WELLCOME TRUST

CENTRE FOR GLOBAL HEALTH RESEARCH

It is a collaborative centre between the LSTM, the University of Liverpool and the University of Glasgow Wellcome Trust Centre for Molecular Parasitology. LSTM's Professor David Lalloo is Director of the Centre, which also delivers the Wellcome Trust Clinical PhD Programme, a scheme supporting the most promising medically qualified clinicians wanting to undertake rigorous research training.

KEMRI/CDC in Kenya

KENYA MEDICAL RESEARCH INSTITUTE · KEMRI

In Kisumu, Kenya, Dr Phillips-Howard and team are collaborating with the Kenya Medical Research Institute (KEMRI), where they are conducting a randomised controlled trial among ~4000 schoolgirls. They 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. They have also initiated a sub-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. They are also collaborating with KEMRI on an impact evaluation of DREAMS interventions on adolescent girls and young women at risk of HIV acquisition in western Kenya.

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 and based in the Accelerator building. Its primary goal is the rapid translation of infectious diseases research to combat the threats of resistance to public health across the globe. CEIDR aims to address the urgent need created by the problem of resistance, with a focus on developing new anti-infectives drugs, insecticides, diagnostics and vaccines to accelerate solutions for existing and emerging infections.

In 2018 CEIDR appointed its first Director, Dr Fiona Marston. She is a biotechnology entrepreneur who has established and managed anti-infectives businesses over the last 17 years. The CEIDR team is focused on developing partnerships with industry, applying the technologies, expertise and resources of LSTM, the University of Liverpool, associated NHS Trusts and overseas partners. Utilizing a range of highly specialised facilities and technologies that accommodate the full lifecycle of discovery, development and deployment, CEIDR will work with industry to capitalise on the expertise and research within the institutions, allowing partners to simplify the R&D processes and reduce time and cost in order to accelerate new products into the marketplace.

The Liverpool-Guangdong Drug Discovery Consortium

The Liverpool-Guangdong Drug Discovery Consortium, in collaboration with University of Liverpool and academic institutes in Guangdong, China, is 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 Research (CDDR) 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 LSTM, the London School of Hygiene and Tropical Medicine, the Jenner Institute at Oxford University and Public Health England and is strategically placed to deliver an unprecedented portfolio of domain specific expertise in all the key research areas of interest. The Consortium realised ca. £40 million in follow-on funding from the CiC investments, the majority involving Consortium, industry and external partners with projects ranging from diagnostics, vaccines, therapeutics, insecticides and novel interventions.

The Global Alliance to Eliminate Lymphatic Filariasis (GAELF)

GAELF supports WHO's Global Programme to Eliminate Lymphatic Filariasis (GPELF) primarily by advocacy and communication. LSTM hosts the GAELF secretariat since 2004. This year 5 more countries are certified as eliminating LF as a public health problem. The 10th GAELF meeting held in India celebrated progress and reinforced the message to countries to achieve elimination. It also focused on the new initiative of 'triple drug therapy', treatment with ivermectin, albendazole and DEC, which in certain settings will speed elimination

The WHO Weekly Epidemiological Record reports that since the launch of the programme in 2000, a cumulative total of 7.1 billion treatments have been delivered to >890 million people. In 2017, national programmes targeted 585.9 million people for treatment during MDA and achieved programme coverages of 79.4%. Reporting on in-country morbidity management activities are now being reported by 53 of the 73 endemic countries.

Lancaster University

A MRC-funded Translational and Quantitative Skills Doctoral Training Partnership (DTP) in Global Health was established between LSTM and Lancaster University in 2016. 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 has funding to support over 30 PhD studentships. Most projects involve co-supervision of PhD students for collaborative projects in LSTM's departments and along the translational research pipeline continuum. The MRC acknowledged the success of the programme and awarded further funding for an additional ~16 PhD studentships.

The partnership has been 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

Although the formal affiliation with the University of Liverpool (UoL) ended in July 2013 when LSTM obtained higher education institutions status, the academic collaboration to deliver education and research projects 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; WTCGHR; LHP and LIV-TB.

HCRI & MSF

Together with the Humanitarian & Conflict Response Institute (HCRI) of the University of Manchester and MSF, LSTM designed an educational programme which aims to enhance the skills and knowledge of MSF's personnel for stronger operations and leadership in the field.

Mersey Maritime

The Mersey Maritime network represents the interests of the Ports and Maritime Sector on Merseyside. LSTM became a member in 2015, enabling further development of maritime business opportunities, occupational health; pre- and post-travel screening services; training and education.

Liverpool Knowledge Quarter

Knowledge Quarter Liverpool (KQ Liverpool), a 450-acre urban innovation district, is home to influential players in science, health, technology, education, and the creative and performing arts. With over £1bn of new developments completed or underway – and a further £1bn in the pipeline – 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 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 Liverpool Life Sciences Accelerator building, jointly owned by LSTM and the Royal Liverpool and Broadgreen University Hospital Trust, was formerly opened in 2018. It co-locates experts in resistance along with relevant SMEs and provides laboratory space for those looking for answers to the global health risks posed by insecticide and antimicrobial resistance.

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.

This year, the NIHR awarded funding in excess of £13 million to different LSTM based research groups and consortia. These awards established new NIHR Units and Groups looking at lung health, snakebite, non-communicable diseases, sepsis and antimicrobial resistance.

LIV-TB

LIV-TB is a collaboration between LSTM and the University of Liverpool with monthly seminars by its members and visiting researchers. 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, especially in relation to the UN High Level Meeting on TB, which took place in September 2018. Other activities include: opinion pieces published in The Times, The Guardian, and The Observer; coordination of a letter to the Prime Minister signed by over 130 leading UK TB academics from over 20 institutes and hosting the All Party Parliamentary Group on TB, including Nick Herbert MP in November.

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 David Lalloo continues to chair PHE's Advisory Committee on Malaria Prevention in Travellers with Professor Hilary Ranson providing entomological support for the committee. 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 Lalloo 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 PHE, has the aim of protecting the health of British travellers. It seeks to improve travel health advice given by health professionals and provides reliable information to the public, health professionals, travel industry and national government. As co-founder, LSTM has been working with other network partners including the Hospital for Tropical Diseases and LSHTM, both based in London.

FEATURE ARTICLE

Applied Health

The Collaboration for Applied Health Research and Delivery (CAHRD) has been instrumental in securing substantial funding for applied health research in Africa, including from the NIHR which led to the formation of IMPALA as well as the EU funded TB impact programme in Vietnam and Nepal.

CAHRD also remains key in its support of the MRC Doctoral Training Partnership PhD programme. This highlights the commitment of the Collaboration and LSTM in building skills and capacity for applied health research and delivery in low and middle-income countries and continues to build networks to enhance the research to policy interface, notably with engagement with the African Institute for Development Policy.

Health Systems Strengthening Group

The health systems strengthening group at LSTM continues to develop and is particularly proud of having co-hosted the 5th Health Systems Research Symposium (HSR) in Liverpool.

Health systems and human resources

The EC-funded PERFORM2Scale programme, working with district health management teams in Ghana, Malawi and Uganda with EU partners from Ireland, the Netherlands and Switzerland started the management strengthening initiative, with the aim of training future leaders. The documentation of this process is an important part of the research on scale-up and the programme was able to share these experiences with similar projects at the recent HSR symposium.

The 2-year RECAP-SL project, funded by EDCTP has been successful in building the foundations for a health systems research centre at COMAHS. To date, this centre has enabled the development of a Four-year research strategy, an action plan to support sustainable institutional capacity development, a website including a repository of research projects and publications and the provision of robust research methodology training to final year medical students. The project has also supported student and young professional led research activities as a focus on building future leaders for research in Sierra Leone, with two research fellows going on to study at PhD level, ensuring a continuing upward trajectory in both individual and institutional research capacity.

Community health systems

The group continues to research the interface between communities and health systems, shining a spotlight on the quality of care provided by community health workers. In Kenya the SQALE project has developed a robust model adapting and integrating quality improvement approaches to the community health strategy. The work on self-care and HIV self-testing as part of the STAR Initiative in Southern Africa highlights how innovative approaches to diagnosis and care can increase the equity of services and support universal health coverage.

Gender and health

This work is closely aligned with the Sustainable Development Goals and the Leaving No One Behind Agenda. We are continuing to expand work on gender, equity and health systems and have been developing new partnerships and exciting research questions on equity, accountability and well-being in rapidly growing informal urban settlements. We have been spearheading work on intersectional analysis including in chronic diseases, disability and mental health and working in partnership to develop strategies for gender transformative services at the community level in relation to infectious diseases of poverty and anti-microbial resistance.

The group built strategic alliances to better address social determinants of health and to mainstream gender in NTDs, including partnerships with the World Health Organization and Women and Girls NTD Group. The work was recently presented at All Party Parliamentary Group. Exciting new outputs include a special issue (and podcast) in Health Policy and Planning on "Leaving no one behind: the role of gender analysis in strengthening health systems" and papers on gender relations, close to community providers and health systems in fragile contexts. Work with partners to strengthen their capacity on gender and equity analysis continues.

Research capacity strengthening

The Capacitary Research Unit (CRU) has seen a rapid expansion and growth in activities within the last year, as the value and benefits of capacity strengthening efforts are increasingly recognised by donors and are embedded within research projects across multiple scientific disciplines.

The long-standing CRU collaboration with the Royal Society and DFID to support UK-African research consortia (ACBI) moved into its second phase to explore the factors that affect pathways of consortium-affiliated PhD students, and the factors that influence the development of laboratory capacity to support international science research. The outcomes generated will be used to make recommendations to guide current and future DFID and Royal Society research programmes.

The cross-learning created by the ACBI programme will also be utilised by the CRU-led Learning Research Programme (LRP), working alongside the DELTAS Africa consortia in partnership with AESA at the African Academy of Sciences, to produce research-based learning about how to train and develop world-class researchers, foster their careers and collaborations, and promote research uptake.

CRU is collaborating with several LSTM-led international research consortia including IVCC, investigating how Good Laboratory Practice (GLP) certification can be achieved so that lessons learnt, and best practice, can be applied to other African trial sites. With the International Multidisciplinary Programme to Address Lung Health and TB in Africa (IMPALA) programme, CRU is studying and evaluating the integrated multi-disciplinary research and approaches of the programme, identifying the enablers and barriers, and the commonalities and differences, to performing multi-disciplinary implementation research by developing evidence-based case studies to present transferable, cross-cutting recommendations. Findings from both projects will be used as benchmarks for future research consortiums and their activities.

Researchers in CRU are also undertaking structured assessments of partner institutions within GCRF-funded programmes - Strengthening Capacity in Environmental Physics, Hydrology and Statistics for Conservation Agriculture Research (CEPHaS), One Health Regional Network for the Horn of Africa (HORN), Partnership for Increasing the Impact of Vector Control (PIIVEC) - to assess research management and support capacities as well as strengths and weaknesses in research capacity.

Monitoring, evaluation, training and research

The Monitoring, Evaluation, Technical Assistance and Research Group (METRe) is a leading unit for M&E, operations and implementation research in the UK. With funding from the Bill and Melinda Gates Foundation, it supported the Government of Bihar, India, to strengthen and quality assure monitoring and evaluation systems for its ambitious maternal, neonate, child and reproductive health programme. With UNICEF/New York it

Dr Justin Pulford undertaking an institutional capacity assessment at the National Research and Training Center for Malaria (CNRFP), Burkina Faso

developed methods to rapidly assess Child Heath Days in sub-Saharan Africa. METRe has both built the capacity of UNICEF and district Ministry of Health teams in Niger to carry out these assessments using the Lot Quality Assurance Sampling (LQAS) method and to identify gaps in coverage. In South Sudan METRe supported the Ministry of Health to carry out nationwide assessments of knowledge, attitudes and practices for health, and of the quality of clinical care. It also supported the Ministry and the World Bank to plan the new national project in Health System Strengthening. In Nepal METRe supported the Ministry of Health carryout operations research in support of its National Health System Strengthening Project. METRe has now developed a new method that brings together information from probability samples and recurrent information to create hybrid prevalence estimators. It also supported LSTM's NTD programme assess Mass Drug Administration for Lymphatic Filariasis in sub-Saharan Africa.

Evidence Synthesis

A bumper year for evidence synthesis at LSTM with published reviews on vaccines for preventing typhoid fever, prevention and treatment of cryptococcal infection in people with HIV and use of Xpert® diagnostic assays for extrapulmonary tuberculosis; all are linked to guideline development in WHO and India's TB programme. On top of this, the WHO Vector Control Advisory Group met to draw up the first set of malaria vector control guidelines to be based on formal assessment of the evidence through our systematic reviews. So, on the policy front, it's been a stellar year.

The debate continues regarding deworming: Cochrane, Campbell, and others still take a sober view on the effects of deworming programmes, which contrasts with the enthusiasm of the development economists and parasitologists who aim to "deworm the world" of soil-transmitted helminths as a substantial contribution to economic development. Another systematic review controversy was that authors of an animal study that suggested a TB vaccine did not work delayed publication. Deborah Cohen, one of the UK's most respected investigative medical journalists, published an 8-page report in the BMJ and highlighted the complex web of evidence about what really happened.

At the end of the year UKAid agreed a 6-year grant, headed by Paul Garner and Paula Waugh at LSTM, and Taryn Young at the Centre for Evidence-Based Health Care in Stellenbosch, South Africa.

Health Economics

LSTM's health economics & modelling group continues to grow with collaborations across all research departments of LSTM and with over 20 partner institutions in Sub Sahara Africa and Asia, providing academic support in even a larger number of settings across the world. These collaborations lead to additional funding, involvement in ongoing and new LSTM projects, and joint and stand-alone courses.

Projects relate to major and neglected tropical diseases, such as malaria, tuberculosis, HIV-infections, as well as chronic diseases such as diabetes, cardiovascular disease, lung health and cancers. Ongoing collaborative work on the 'Cholera Investment Case' with icddr,b in Bangladesh and on chronic diseases with Johns Hopkins University, are of high global policy impact. The group conduct research on cross-cutting themes, including catastrophic expenditures, poverty-impact of diseases, economic and societal benefits of disease control programmes. The group has created new research evidences on the impact of healthcare financing methods, namely out-of-pocket spending and health insurance on catastrophic health expenditure and poverty as well as on equity in healthcare utilization in a lower-middle income country in South Asia.

The group is currently involved in three NIHR funded projects: on Lung Health and Tuberculosis (IMPALA), HIV and non-communicable and snakebite in 14 African countries, recruiting three new staff members. Additionally, the group has extended the collaboration with the University of Liverpool and Cardiff University to include proposal development for research funding on health technology assessment of Sepsis management in NHS.

Disease Data Management System (DDMS)

The Disease Data Management System (DDMS), an online decision-support tool targeted at vector-borne disease control programmes, continues to be implemented with national vector control programmes in Sub-Saharan Africa, India and South-East Asia.

The database had a makeover. Incorporating enhanced spatial functionality including interactive geo-dashboards, interoperability with other major health information systems, intelligent dataset and report creation, an updated version DDMS Plus (DDMS+) was released in early 2018. LSTM researchers are currently evaluating this tool with project partners in Zambia and India.

In India additional DDMS+ functionality and usability has recently been piloted using the Open Data Kit (ODK) platform for mobile data capture. New mobile data entry functionality for the DDMS+ has recently been piloted in India utilising the integration of the Open Data Kit (ODK) platform. 8 sentinel sites across multiple states in North-East India (Bihar, West Bengal, and Jharkhand states) are collecting data through the Visceral Leishmaniasis entomological surveillance programme in conjunction with CARE India and other local and regional stakeholders. Site staff at the sentinel site in Bihar, India, successfully road-tested the app for field data entry prior to wider roll out in 2018.

The DDMS+ is also being implemented in the Philippines in a collaboration between LSTM, the Philippines's Research Institute of Tropical Medicine and Institute Pasteur. The DDMS+ will be used as part of Lipa City Health Office's entomology and case surveillance programme for dengue in parallel with a research project investigating the use of In2Care® auto-dissemination devices for reducing dengue transmission.

Health Systems Research 2018 Conference

The 5th Health Systems Research 2018 conference took place in Liverpool. This biennial research conference is part of Health Systems Global, the first international membership organisation dedicated to promoting health systems research and knowledge translation. It is the first time the conference has been held in the UK, after a successful LSTM led bid.

2018 was a strategic year to host the conference as it marked relevant anniversaries: the 70th birthday of the UK's National Health Service; 40 years anniversary of Alma Alta Declaration and 10 years anniversary of Liverpool as European City of Culture. The symposium's theme: Health Systems for All in the SDG Era encapsulated the spirit of these historical commitments and brought them forward into current debates and actions on the Sustainable Development Goals, and especially, Universal Health Coverage. Specific sub-themes were multi-sectoral partnership; community health systems; engaging with the private sector and leaving no-one behind.

Ahead the conference, LSTM hosted the Emerging Voices for Global Health programme. This year 38 Emerging Voices from 32 countries were selected for the programme. The Emerging Voices cohort was here for 9 days for facilitated leaning and exchange, including a health systems day, with visits to health organisations in Liverpool. Emerging Voices concluded with a pre-conference held at LSTM to showcase their work, commitment and ideas in the field of health systems and policy research and to promote exchange with LSTM staff and students.

The HSR 2018 conference itself was a great success with vibrant debate and participation: 2,368 delegates attended, with 146 countries represented and 52% of delegates were from LMICs and most speakers were women. The hashtag #HSR2018 had a reach of 6,204,009 enabling debate and exchange with people not able to be there in person. The conference hosted 4 plenaries, 125 parallel sessions, 451 posters, several launches, and Thematic Working Group special sessions. LSTM facilitated sponsorship from DFID, with 30 DFID health advisors attending the conference and Minister Alistair Burt MP speaking at the opening plenary.

There were several innovations in HSR 2018, including Liverpool based health organisations presenting their work in the Community Corner. There was the largest ever exhibition of photovoice, which in partnership with Liverpool John Moores University was curated and displayed within the Arena and showcased in the Museum of Liverpool, enabling the public to interact with the contexts and issues discussed at HSR2018. Delegates were also invited to take part in a public health walks, guided walks around Liverpool to learn about our public health history. First time Media Fellows reported on the symposium resulting in media coverage in India, Russia, the Middle East, Africa and Latin America.

In the closing plenary "The Liverpool Statement" was read out, which summarised learning under each of the sub-themes, highlighting the importance of embedded and implementation research and knowledge translation. The statement concluded by "affirming the importance of ensuring that all people are at the centre of health systems in the conversations and commitments to be made at the Global Conference on Primary Health care in Astana and subsequently at the 6th Global Health Systems Research Symposium in Dubai." And to close the circle Tim Martineau handed over the HSR key to the hosts of the Dubai conference.

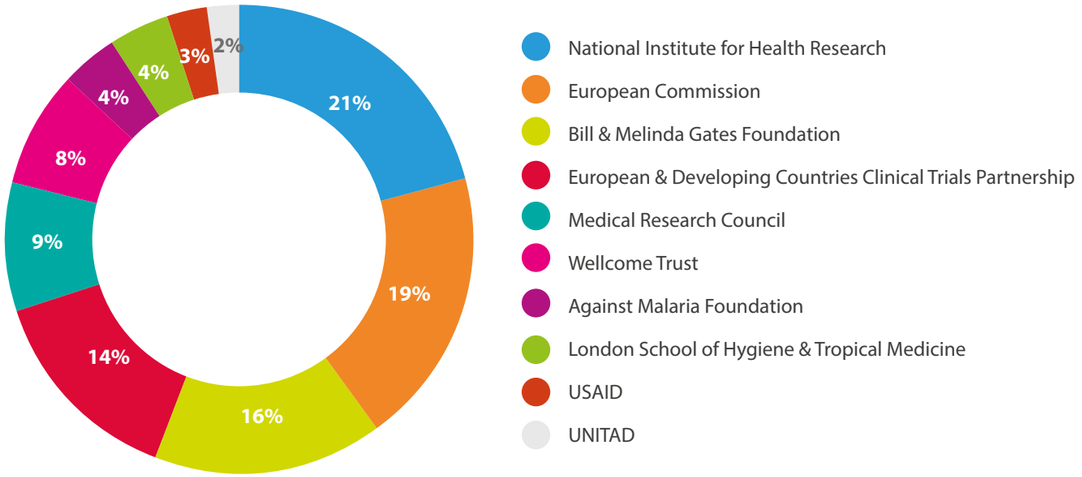
LSTM Professor Sally Theobald at HSR2018

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 2016/17 and 2017/18.

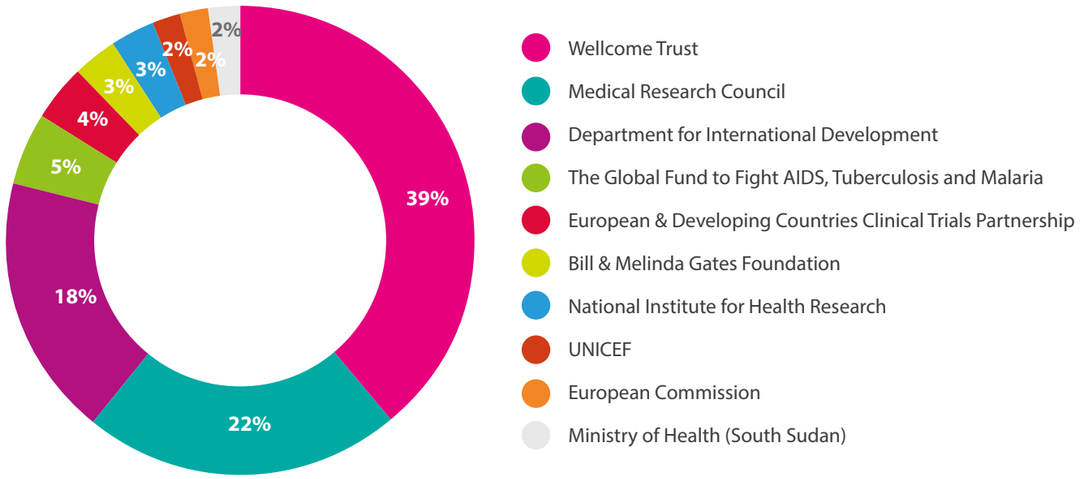
Top 10 research funders (by total contract value) - FY 2016/17

Source: *PowerBI*



Top 10 research funders (by total contract value) - FY 2017/18

Source: *LSTM financial accounts*



Research Support

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 Management Committee on the strategic direction of research, identifying priority areas for research, as well as by 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. The first cohort of these fellowships were awarded in 2018 to Dr Victoria Ingham, Dr Ghaith Aljayyoussi and Dr Jamilah Meghji.

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 Dr Kondwani Jambo, Dr Linta Grigoraki, Dr Samantha Donnellan, Dr Eric Lucas and Dr Helen Nabwera.

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 out of the 66 funded 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).

MRC DTP students

LSTM ANNUAL REPORT **2017/18**

Lake Albert, Uganda, during a schistosomiasis survey. Snails were sampled in the lake. All 30 children surveyed in the nearby school tested positive for schistosomiasis despite regular treatment with praziquantel.

Photo: Michelle Stanton

Education

The expansion of LSTM's education provision is one of the three goals set out in the 2017-2023 Strategic Plan. With the granting of degree awarding powers in September 2017, LSTM now has both the ability and opportunity to examine, and where necessary, revise existing teaching practices and explore exciting new delivery models. LSTM's commitment to achieving its ambitions for education has seen the creation of the new post of Dean of Education and significant investment in the teaching and learning infrastructures.

Professor Phil Padfield - Dean of Education

First Dean of Education appointed

Professor Phil Padfield took up the position as Dean of Education in May of 2018. Formerly, he was the Associate Dean for Postgraduate Taught Education for the Faculty of Biology, Medicine and Health of the University of Manchester and the Director of the Manchester Academy for Healthcare Scientist Education (MAHSE). Professor Padfield is a principal fellow of the Higher Education Academy with experience in postgraduate taught education. He was responsible for establishing MAHSE as the national lead for the education of NHS healthcare scientists and has a proven track record in managing and growing complex postgraduate education portfolios. Along with past colleagues in Manchester he was awarded the 2018 Collaborative Award in Teaching Excellence by the Higher Education Academy.

Global Health Week

Education began the MSc programmes with a new approach for 2017-18. With a range of high energy activities, it designed the opening week to bring together students across courses, and to start thinking 'big picture' on some of the contemporary challenges facing researchers and practitioners in international health.

The first half of the inaugural 'Global Health week' began with a series of inspiring talks from Professors Janet Hemingway, Mark Taylor, Shabbar Jaffer and many other lead researchers to provide insight into the multidisciplinary nature of current projects and the complexities facing research teams working to translate research in global contexts. Then it was over to the students, who were asked in teams to prepare to debate one of a number of topics, from the barriers to implementing research in low-income countries, to the reactions of the media to recent outbreaks of Zika and Ebola, and to the strained reluctance of medical journals still to accept qualitative research. As well as debating groups, 'public engagement' teams were asked to think of creative and engaging ways to communicate these complex ideas to a lay audience.

The final-day culminated in student debates and public engagement presentations delivered not only with passion and intelligence, but also enriched with students' own working experiences and insights, a valuable reminder of what our students bring with them to their studies here, representing 31 nationalities from Argentina to Zambia.

Creation of an Active Learning Laboratory

This year has seen significant investment in LSTM's physical teaching and learning environment, with three innovative, technology-rich spaces being built to address the needs of our existing campus-based students and to support the school's teaching portfolio expansion.

At the centre of the development is a state-of-the art, multi-functional, Active Learning Laboratory. Following a donation of The Garfield Weston Foundation, the lab has been carefully designed to support learner-centred approaches to teaching. The flexible layout and interactive A/V 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 new teaching and learning space presents a significant departure from LSTM's more traditional classrooms and seeks to encourage the growth of teaching practices which support students to work collaboratively and actively participate in the learning process, which an increasing evidence base demonstrates can be more effective. Research on the use of the new facility will play a role in shaping educational approaches in support of LSTM's teaching expansion and will influence the design of future learning spaces.

A smaller collaborative learning room complements the Active Learning Lab, and a media recording suite provides a dedicated space for academic and professional support staff to develop learning resources and deliver live sessions to students studying on distance and blended learning courses in the UK and overseas.

Turning on the LIGHT

The high quality of the learning experience that LSTM offers to its students is underpinned by the commitment and professionalism of its staff. Teaching and research are the core components of LSTM's mission - the relationship between the two is symbiotic and LSTM recognises the value of both. Dr Sue Assinder, Director of Academic Development, launched a new scheme to reward and existing good practice, whilst nurturing and developing excellence in supporting learning and in the leadership of teaching.

Dr Sue Assinder - Director of Academic Development

The Leading in Global Health Teaching (LIGHT) Professional Recognition Scheme is designed to develop and recognise excellence in supporting learning at LSTM. LIGHT takes a flexible approach to evidencing professional practice in supporting students, and so will be of interest to a broad range of participants, including those based overseas. It is applicable at all career stages, and to those in a wide range of roles, both in academic and professional services departments. Postgraduate research students are also eligible to participate.

Through LIGHT, students will be supported in their learning by teachers who hold professional qualifications explicitly linked to national standards. LIGHT is mapped to the UK Professional Standards Framework for Teaching and Supporting Learning in Higher Education and is externally accredited by Advance HE (formerly the Higher Education Academy). This means that any member of LSTM who completes LIGHT will receive a nationally recognised HEA Fellowship in the appropriate category. Accreditation by the HEA demonstrates to students and potential students a commitment to the quality of the learning experience. As the number of staff who hold a professional qualification in teaching increases, LSTM's reputation for excellent teaching will be enhanced.

HEFCE (Office for Students) Catalyst Bid

Following a competitive bid process, LSTM secured £1.02m from HEFCE (Office for Students) to support our Teaching Expansion Plan for 'Developing the Next Generation of UK Global Health Leaders.' The bid was endorsed by key regional players such as the Liverpool City Region Combined Authority and Liverpool City Region Local Enterprise partnership, the non-governmental organisation Médecins Sans Frontières (MSF) and key employers in the global health field.

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

This award underlines HEFCE's confidence in LSTM as a centre for excellence in postgraduate teaching. The project takes an evidence-based approach to our portfolio development, so that we are able to address a current skills gap and ensure that UK health professionals have the skills to tackle issues affecting the UK within a global context.

The award also supports the Skills Strategy for the Liverpool City Region, cementing its position as a world-leading centre of infectious disease and global health, and was supported by both Liverpool City Region Combined Authority and Local Enterprise Partnership.

The initiative will include industry and field-led curriculum co-design and delivery that will ensure the readiness of the UK's health professionals for outbreaks such as Ebola and Zika, expertise on antimicrobial resistance, and humanitarian and disaster response management. The transformation of LSTM's education provision will attract global and local talent to strengthen the global health expertise in Liverpool, and LSTM's global footprint.

Promotional Activities

Michael Lurie - Director of International Education & Knowledge Exchange

Led by the Director for International Education, Michael Lurie, Education has increased its promotional activity based on a strategic integrated marketing plan, embedding consistent and targeted messaging to key audiences. This project, in partnership with LSTM's Fundraising and Communications Teams, is an enabler to meet the deliverables set out in LSTM's Strategic Plan.

This plan has culminated in campaigns that have supported initiatives to improve student recruitment of current programmes. These campaigns also assist new initiatives such as the Humanitarian MSc Humanitarian Practice partnership with MSF and University of Manchester as well as the newly launched MSc Global Health programme.

As part of widening access to markets which are less familiar with LSTM, Education also conducted external market research to refine its messaging and approach to these audiences to engage with them more effectively.

LSTM continued to showcase its educational offering through postgraduate open days. These have been celebratory events with active and supportive staff involvement and have directly contributed to recruitment of new students.

Partnership Activity

Over the past year, we have worked with MSF and the Humanitarian & Conflict Response Institute (HCRI) of the University of Manchester to design an educational programme which aims to enhance the skills and knowledge of MSF's personnel for stronger operations and leadership in the field. This partnership provides an opportunity to showcase our offering to the wider NGO market and will enhance our footprint and impact in the global humanitarian context. The programme will commence delivery in January 2019.

Other milestones:

- **For the first time in LSTM's history, an intake of over 100 Masters students**
- **Growth in uptake of scholarship funds from 40% in 2016/17 to over 90% in 2017/18**

StudentsandCourses

TOTAL TAUGHT STUDENTS
688
Overseas **252**
HEU (UK & EU) **436**

RESEARCH STUDENTS 2017-18
TOTAL **116**
Overseas **64**
HEU (UK & EU) **52**

SHORT COURSES/ MODULES **148**
Overseas **42**
HEU (UK & EU) **106**
Various MSc modules & stand alone short courses

86 ONLINE COURSES
Overseas **26**
HEU (UK & EU) **60**
3 online courses run multiple times (TB, Travel Vaccinations & Malaria)

MScs

MSc in International Public Health (all streams)
TOTAL **35**
HEU (UK & EU) **24**
OVERSEAS **11**

MSc in Humanitarian Studies
TOTAL **6**
HEU (UK & EU) **6**
OVERSEAS **0**

Biology & Control of Parasites & Disease Vectors
TOTAL **21**
HEU (UK & EU) **18**
OVERSEAS **3**

MSc in Tropical & Infectious Diseases
TOTAL **10**
HEU (UK & EU) **3**
OVERSEAS **7**

Molecular Biology of Parasites & Disease Vectors
TOTAL **24**
HEU (UK & EU) **17**
OVERSEAS **7**

MSc in Tropical Paediatrics
TOTAL **6**
HEU (UK & EU) **0**
OVERSEAS **6**

PROFESSIONAL DIPLOMAS

Diploma in Tropical Medicine & Hygiene
TOTAL **155**
HEU (UK & EU) **129**
OVERSEAS **26**

Diploma in Tropical Nursing
TOTAL **102**
HEU (UK & EU) **58**
OVERSEAS **44**

Diploma in Humanitarian Assistance
TOTAL **10**
HEU (UK & EU) **4**
OVERSEAS **6**

Dip UK Medical Practice
TOTAL **33**
HEU (UK & EU) **0**
OVERSEAS **33**

Dip Sexual & Reproductive Health in Low Resource Settings
TOTAL **11**
HEU (UK & EU) **1**
OVERSEAS **10**

PROFESSIONAL CERTIFICATES

Certificate in International Health Consultancy
TOTAL **13**
HEU (UK & EU) **10**
OVERSEAS **3**

Certificate in Lot Quality Assurance Sampling (LQAS)
TOTAL **28**
OVERSEAS COURSE

Clinical Diagnostic Parasitology Laboratory (CDPL)

November 2017 brought continued success for the Clinical Diagnostic Parasitology Laboratory (CDPL) when UKAS accreditation to ISO15189:2012 International standard was maintained for all tests placed on scope of practice. This accreditation demonstrates the quality service provided by the 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.

Jayne Jones - Manager of CDPL

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

The facility 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. The CDPL continues to gain high marks for these four schemes.

In addition, CDPL continues to integrate with LSTM diagnostic research team led by Dr Emily Adams. This link provides the mechanism for validation and verification of molecular tests that will enhance the portfolio of the diagnostic testing performed within the CDPL. This link also strengthens the bonds between clinical work and research being performed within LSTM. Throughout this year the link with LSTM diagnostic research team has allowed the evaluation of a faecal PCR panel that will be able to be used as a diagnostic test within CDPL. The CDPL has seen the PCR suite within the unit be updated and utilised in a way that will allow streamlining of PCR Diagnostic panels within the unit.

Work with the Ministry of Defence (MOD) continues and CDPL is contracted to perform diagnostic work for another 3 to 5-year period within certain MOD personnel groups. The samples arrive annually in bulk but the team manages to process these in a timely manner.

LSTM's IT department works with CDPL to streamline the laboratories Quality Management System (QMS). The QMS is a manual system that has evolved over time, the laboratory manager is working with IT to see development of systems that can be utilised on a tablet whilst staff are working around the laboratory suite. This will see a major benefit to CDPL's staff and electronic systems.

CDPL's senior biomedical scientist Iain Slack examining samples

The 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). The study will focus on detecting infections that are treatable and/or preventable. The 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 team is managed by Mrs Jayne Jones who has worked in the CDPL for 26 years. She is supported by biomedical scientists Iain Slack, Ann Marie Riley and Jessica Mason, and Medical laboratory assistant Paula Wright who has 34 years' service at LSTM. The team are therefore highly experienced in diagnostic parasitology.

Well Travelled Clinics

Well Travelled Clinics (WTC) had its strongest ever trading year ever in 2017-18 with patient numbers up by 13.2% and income increasing by 12.2% on the previous year. Turnover went over £1 million for the first time since the company's inception and its profitability increased significantly.

Philippa Tubb - WTC Managing Director

Specialist travel related Occupational Health (OH) services continue to provide a significant contribution to WTC's stronger business performance, not only in relation to the specialist medical services we provide, but OH also contributes to the income in terms of additional vaccine and malaria tablet sales. WTC is continuing to develop its specialist clinical occupational health services and have won additional corporate contracts during the year.

In December 2017 and January 2018, WTC supported the emergency deployment of two UKMED emergency medicals teams to the Diphtheria Outbreak in Bangladesh, this involved WTC staff delivering off-site clinics over the Christmas and New Year period to ensure that all these emergency staff were fully vaccinated prior to their deployment. WTC also had to carry out screening of these deployees on their return at two UK airports. This type of specialist rapid response, utilising our travel, tropical and public health knowledge is one of WTC's unique selling points and means that we can provide a complete one stop service to international humanitarian organisations.

The WTC Chester branch extended its opening hours in September 2017 from 4 to 5 days per week, and there has been a small increase in client numbers as a result of this. Chester's clinical activity has been constrained by staffing challenges during the year, and it is hoped additional clinical capacity will be available in the year ahead.

WTC launched a new website in September 2017 and feedback from clients has been very positive.

WTC runs a range of education and learning activities. This year it carried out quarterly teaching on the UKMED pre-deployment and deployment courses; travel health sessions for Chester Zoo personnel and tailored educational sessions for some of its corporate clients. WTC ran a three-day Introduction to travel health course in February 2018 as well as two online modules in travel vaccination and malaria prevention several times during the year. WTC is working on two further online modules and will be offering a new online Diploma in Travel Health in 2019.

2017/18 AT A GLANCE

THIS YEAR, WELL TRAVELLED CLINICS:

- Saw **11,659** patients
- Answered over **61,000** phonecalls
- Gave **12,306** vaccines
- Dispensed **54,674** malaria tablets
- Sold **2247** bottles of DEET insect repellent
- Carried out **159** sea-farer medicals for maritime workers
- Carried out **376** pre-deployment medical screenings for overseas workers
- Carried out **46** oil & gas medicals for offshore workers

Liverpool Insect Testing Establishment (LITE)

Liverpool Insect Testing Establishment (LITE) has been accelerating the search for new public health insecticides, with IVCC, a product development partnership. Ever since LITE was established by LSTM' Department of Vector Biology 8 years ago, it provides an efficient service to industrial partners to screen new chemicals against insecticide-resistant mosquito populations, using a variety of biological assays.

Helen Williams - Head of LITE

The LITE team moved into a bespoke designed new facility, which is part of in the new Liverpool Life Sciences Accelerator (LLSA) building. This new facility enables us to expand the services we offer and the range of clients we provide for, aiding us to achieve our vision of being the partner of choice for evaluating products to control insect disease vectors.

The new facility also enables us to dramatically increase our mosquito rearing capacity and to implement additional bespoke methodologies including those to assess spatial repellent products and to investigate behavioural responses to insecticides.

Once new processes are embedded, an application will be made for Good Laboratory Practice (GLP) accreditation to the Medicines and Healthcare Products Regulatory Agency (MHRA). This will mean LITE can expand and attract additional clients, as data will be able to be used directly into regulatory submissions for new vector tools.

Part of the processes to be embedded into LITE is iPassport. This is a Quality Management System (QMS) that will transform the documentation process in LITE from paper to electronic, making documentations more efficient including review and approval of documents and equipment record management.

LITE technician Pauline Ambrose applying mosquitoes to cement surfaces treated with insecticide formulations in a WHO cone test.

IVCC

IVCC Vector Control Saving Lives

In 2017/2018, IVCC continued to expand in scope and responsibility. In May 2018, the Australian Government's Department of Foreign Affairs and Trade (DFAT) awarded IVCC a five-year A$18.75 million grant to support their Indo-Pacific Health Security Initiative. This program is designed to contribute to the avoidance and containment of infectious disease threats with the potential to cause social and economic harms on a national, regional or global scale.

Dr Nick Hamon - CEO of IVCC

Unitaid and the Global Fund to Fight Aids, TB and Malaria awarded IVCC $66million to support the introduction of novel dual active ingredients long lasting insecticide treated nets, including price support and field trials to assess performance and public health value. Additional funding is being provided by the Bill & Melinda Gates Foundation to provide in trials and volume guarantee support.

The Swiss Agency for Development and Cooperation renewed its core grant to IVCC for an additional three years.

With the support of these funders as well as DFID and USAID, the focus of IVCC's strategy remains the development and delivery of effective vector control products to combat insecticide resistance. To do this we must identify and develop effective new insecticides.

Two new insecticides have been introduced for vector control during the past year: Clothianidin, a neonicotinoid which is the active ingredient in Sumitomo's IRS, SumiShield® 50WG, and Chlorfenapyr, a pyrrole, which is a component of the first pyrethroid+ ITN, Interceptor® G2, developed by BASF. This is good progress, but it is not enough. Insecticides used in vector control are exposed to significant pressure of resistance developing.

To prevent disease transmission through vector control, it is important that insecticides remain effective through proactive insecticide resistance management. This can be facilitated by using products in mixtures or rotation, as recommended by WHO, to prevent mosquito populations developing insecticide resistance. Use of products at a fully effective dose rate is also important to prevent resistance developing.

Further novel products are also needed if vector control is going to deliver its' part in malaria eradication. The requirements are for new chemistry which works in a different way to current products, to avoid pre-existing resistance mechanisms.

In 2018 IVCC completed the evaluation of all existing insecticide chemistries used in agriculture for their suitability for ITN and/or IRS. From a starting point of hundreds of candidates, we now have a handful of compounds which are being evaluated as potential mixture partners for ITNs. This is complemented by our industry partner projects where the focus in 2017-8 has been to select individual compounds as development candidates. Once identified the larger scale production of these compounds is carried out so that we can undertake more extensive safety testing and formulation development as well as testing the compound in prototype products for field performance.

Industry partners signing the ZERO by 40 Declaration at the London Commonwealth Heads of Government Meeting, April 2018

Moving from disease control to malaria eradication will rely on a toolbox of solutions in which vector control continues to play a leading role. However. innovation cannot just be about new product development; rather, it is the responsibility of the entire stakeholder community to accelerated pathways to approval and implementation, identify key enabling technologies, as well as innovative new funding, partnership and delivery models.

One example a new type of partnership is represented by ZERO by 40. The CEOs of the major research-based agrochemical companies gathered at the World Economic Forum in Davos back in January at a meeting hosted by Bill Gates and IVCC. At the Commonwealth Heads of Government Meeting in London just three months later, these same companies made a public commitment on a world stage to work collaboratively to play their part in advancing vector control innovation, with a goal of eradicating malaria by the year 2040. This represents not only an extraordinary opportunity for malaria eradication but also for leading crop protection companies to demonstrate they can be not only 'best in the World' but also 'Best for the World' at the same time. ZERO by 40 formalizes the partnership between the leading crop protection companies and IVCC in vector control to help make continued progress in the fight to end malaria. More information on ZERO by 40 can be found at ZEROby40.com.

Far East Prisoners Of War (FEPOW) Project

The collaboration between ex-FEPOWs and the Liverpool School of Tropical Medicine is the longest in LSTM's history, beginning in late 1945 and still ongoing. These men suffered exposure to tropical diseases, under-nutrition, overwork and maltreatment during three-and-a-half years of imprisonment under the Japanese from 1942 to 1945.

After release many suffered a variety of physical and psychological problems related to their POW experiences, which included post-traumatic stress disorder (PTSD), relapses of malaria and amoebic dysentery, hepatitis B – related liver disease, chronic infections with the nematode worm Strongyloides stercoralis, and permanent neurological damage due to vitamin B deficiencies.

LSTM has been at the forefront of assessment and treatment of ex-FEPOWs. Between late 1945 and the end of 1999, over 4,000 of these men were seen at LSTM and in addition a large body of research has been carried out related to their unique long-term medical problems, with 15 peer-reviewed papers appearing in the medical literature.

With declining numbers of ex-POWs clinical contact ceased by 2000 and it was decided to continue the project from a medical history viewpoint, particularly with regard to the role of LSTM in their post-war story.

Two books have been published by Palatine Books in recent years – Captive Memories, by Meg Parkes and Geoff Gill, in 2015, and Burma Railway Medicine, by Geoff Gill & Meg Parkes, in 2017. These books continue to sell well, and the authors give regular lectures related to the research charted in both books. One such talk was in London in September 2018, when Professor Geoff Gill and Meg Parkes delivered the George Blair Memorial Lecture to the "Friends of Millbank" – a group of present and past members of the Royal Army Medical Corps (RAMC). Dr George Blair was himself a Far East POW RAMC medical officer who strived to keep desperately sick men alive in camps in Taiwan.

A major activity during 2018 has been preparations for an exhibition of contemporary British FEPOW art, which will take place at Liverpool University's Victoria Gallery & Museum, as of October 2019. The exhibition 'The Secret Art of Survival' will include over 100 items of original art, many of which have not been seen publicly before. These works represent just a quarter of the total number of individual pieces of artwork created during captivity – kept hidden, brought home, only to largely remain hidden from view for decades – which the LSTM FEPOW research team has uncovered, helped by an initial grant from the Wellcome Trust.

Meg Parkes and Geoff Gill receiving their awards

This botanical sketch below is one of the previously unseen artworks, created by Flight Lieutenant Leslie Audus RAF in captivity in the Dutch East Indies sometime in 1943. A botanist and academic pre-war, Audus was to become Professor of Botany at the University of London post-war. Captured in Java and shipped to the Spice island of Haruku, he was one of a handful of scientists in captivity who was responsible for large-scale production of yeast, providing a replacement for essential B vitamins to the POW's depleted diet and saving the lives of hundreds of men.

Botanical study by FlLt Audus (© Audus family).

In the lead up to the exhibition links have been made with Liverpool schools, three of whom – North Liverpool Academy in Everton, Pleasant Street Primary in the city and Neston High School in south Wirral – are taking part in the FEPOW education project running throughout this academic year.

To raise the balance of the funds needed for the exhibition LSTM's fundraising team launched a Crowdfunder appeal in mid-September. The response has been swift and generous, with the initial target of £6,000 reached within the first three weeks.

For more information about the FEPOW project and forthcoming art exhibition go to www.captivememories.org.uk

Public Engagement

LSTM staff and students have been working with a wide range of artists, festival organisers, media and creative specialists to engage existing and new audiences with their work.

Bluedot Festival

This annual festival that combines science, arts and music, held at Cheshire's Jodrell Bank, brought together researchers from the Departments of Parasitology and Vector Biology. Professor Mark Taylor delivered a 'Dot talk' looking at whether parasites, typically seen in tropical climes, are moving north. Especially younger members of the audience asked many questions, such as what would happen if parasites were found on the International Space Station. Vector Biology's Dr Mark Paine talked about the possibility of eradicating malaria before humans reach Mars.

LSTM's exhibit stand at the Bluedot was shared between the two departments and the Centre for Snakebite Research and Intervention (CSRI). A team, led by Ms Aislinn Currie-Jordan, showcased games and activities relating to the theme Club Tropicana, whilst the CSRI team showed festival-goers of all ages how to wrangle a snake. Throughout the three-day festival, CSRI worked with a group of visual artists called the 'Snake Wallahs' who paraded the fields and arena wowing the 4,000-strong audience with a 16-foot spitting cobra puppet.

Bluedot poster listing LSTM's Mark Paine

> *"It has been brilliant for us collaborating with LSTM at Bluedot…we would like to thank the LSTM venom scientists who were so accessible and open to the idea of collaboration and their positivity during the festival. We have particularly enjoyed having a sense of purpose and value to our Snake through collaborating with your venom scientists."*
>
> ***The Snake Wallahs***

LSTM PhD student Sarah Alharbi explains Swab and Send to a visitor

Swab and Send

Dr Adam Robert's Swab and Send project was taken to the New Scientist Live in London, a four-day festival of cutting-edge science, where approximately 40,000 members of the public met scientists, tried some hands-on activities or attended inspiring talks. The Swab and Send team encouraged the audience to take swabs of the exhibition hall and 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. The Swab and Send team also swabbed the Bloodhound - the fastest car in the world, the Mars Rover and a spacesuit. Members of the public also had the opportunity to talk to the team to discover how bacteria have adapted to fight back against antibiotics and see what the world would be like if effective antibiotics no longer existed.

The team have also taken part in 'Science Lates' at London's Science Museum, an adults-only, after-hours theme nights that take place in the museum which often sees up to 4,000 visitors over the course of the evening.

The Swab and Send team processed over 800 swabs from a variety of imaginative locations worldwide including a Welsh Slate mine, a Japanese bath house and excavations of LSTM's car park during the archaeological dig for the Galkoff's and the Secret Life of Pembroke Place project.

LSTM swabbing the Mars rover at New Scientist Live

> *"I had the best experience at New Scientist Live. [I] learnt so much and made some good links for the college I work at."*
>
> ***Visitor at the LSTM stand at New Scientist Live 2018***

Big Bang North West

The Big Bang North West shows young people in England's northwest region the exciting and rewarding career opportunities available to them by bringing classroom learning to life through fun and interactive activities. A team from the Department of Parasitology, led by Dr Kelly Johnston, returned to the Big Bang North West in the summer to give 7,000 local school students the opportunity to see a wide selection of gruesome parasites and learn about the opportunities and challenges being a drug discovery scientist.

> *"…The Big Bang North West is key to helping us inspire a love of scientific enquiry and an awareness of the careers this enables."*
>
> ***School teacher attending the Big Bang North West.***

SciFri

SciFri, an LSTM initiative, is a BBC Radio Merseyside segment involving researchers across LSTM, Liverpool John Moores University and the University of Liverpool taking place every Friday morning.

Regular participants of SciFri include Dr Nick Casewell, Professor Daniela Ferreira, Dr Emily Adams, Dr Tom Fletcher, Dr Lee Haines and Dr Adam Roberts who have discussed a range of topics from snake venoms right through to tsetse flies and diagnostics. This year has welcomed new members to the SciFri team including Professor Kevin Mortimer, Dr Simon Jochems, Meg Parkes and Jane Ardrey.

Pint of Science

Pint of Science is an annual science festival that brings researchers to local pubs to show the latest scientific discoveries. Pint of Science held nearly 500 events across nearly 30 cities in the UK, and the University of Liverpool and LSTM hosted the second Pint of Science festival, this year, in Liverpool.

Dr Kevin Mortimer, Reader in Respiratory Medicine, gave a talk entitled "Mirror Mirror on the Wall: Is it true Smoke Killed them All?" at the Dockleaf bar in the Baltic Triangle. His talk introduced the dangers of smoke and the health problems associated with the 'killer in the kitchen' - household air pollution - to the audience. LSTM's Ms Sherin Pojar and Dr Samantha Donnellan also gave short two minute talks as part of Shots of Science during the festival.

Perception Machine at Liverpool Tate

Vector Biology's Dr Lee Haines spoke at Liverpool LASER at Tate Liverpool, an event organised by artists at Liverpool John Moores University. LASER (Leonardo Art Science Evening Rendezvous) Talks are an international program of evening gatherings that bring artists and scientists together for informal presentations and conversations on art, science and technology.

IMPALA at World Lung Day

The LSTM based IMPALA consortium invited members of the public to walk through a 12 feet high inflatable set of lungs to learn about asthma and other lung conditions for World Lung Day (25 September), supported by LSTM's Accelerator Research Clinic (ARC) who set up their Snakes and Ladders game to communicate their research into finding vaccines for pneumonia.

LSTM in the media

Over the past academic year 119 LSTM news stories were shared with the media, resulting in just over 5,000 mentions in online, broadcast and print media. LSTM's social media following grew rapidly over the same time, ensuring LSTM's news and marketing output reaching a larger audience than ever before.

LSTM was featured as part of a story about a man who contracted visceral leishmaniasis in Spain and was treated by Dr Nick Beeching at the Royal Liverpool University hospital. Granada TV interviewed Dr Beeching alongside the patient about his shock diagnosis and treatment, while Dr Alvaro Acosta Serrano spoke about the research his group are carrying out in the vector of visceral leishmaniasis, the sandfly. The story was also carried by the Liverpool Echo and the Daily Mail.

Dr Nick Beeching also continued to offer advice to the scriptwriters of Call the Midwife. He has consulted on two episodes this year, one which aired in February, while the other, this time about Anthrax is for the upcoming Autumn / Winter schedule. He also took part as an expert on BBC One's Who Do You Think You Are? programme. The production team filmed with a Paralympian Jonnie Peacock at LSTM talking about his great, great grandfather who died of anthrax poisoning in Liverpool before the formation of the NHS. The programme aired in August this year, with this series attracting around six million viewers per episode.

Dr Adam Roberts, Senior Lecturer in Antimicrobial Chemotherapy and Resistance has appeared in the media several times talking about his research. He also recently consulted on a drama aired on BBC Radio 4 called the Truth About Hawaii, which ran daily over two weeks in February. The drama followed a young girl and her family coping with a bacterial infection in the near future where antibiotics no longer work and received positive critical coverage.

Dr Roberts also took part in a BBC programme about antibiotic resistance in which he featured as lead microbiologist, promoting his Swab and Send project. The programme, presented by Angela Rippon, visited Adam's lab at LSTM and will be aired on BBC One in the Autumn / Winter schedule. He was also interviewed after members of the Telegraph's news team swabbed their refillable water bottles and mugs to see what bacteria was growing on them.

LSTM's experts continue to be called upon to offer advice and expert opinion, not only on their own research, but on that of others as well as stories in the news. The BBC World Service called upon both Dr Lisa Riemer and Dr Grant Hughes in the last few months to talk about genetically modified mosquitoes, with Dr Riemer talking about the benefits of releasing sterile mosquitoes into wild populations and Dr Hughes about

CBBC's Operation Ouch records at the Centre for Snakebite Research & Intervention

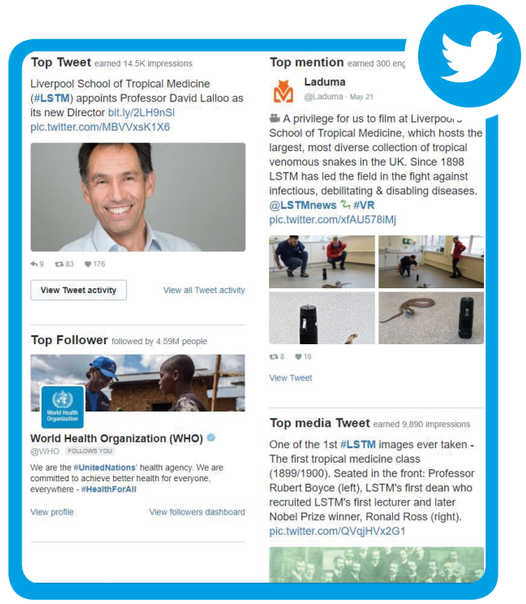
Wolbachia infected mosquitoes being used to prevent the spread of diseases. Dr Nick Casewell was interviewed by several news outlets, including the BBC about a man being bitten by the decapitated head of a rattle snake.

LSTM's Centre for Snakebite Research & Intervention, (CSRI), remained in the spotlight, with Dr Nick Casewell and members of his team being involved in Venom: Killer or Cure at the Natural History Museum in London. As well as LSTM's involvement being publicised widely Dr Casewell provided interviews which were shown through the exhibition. Drs Casewell and Stuart Ainsworth were also interviewed following the publication of an academic paper outlining their initial research looking at treating the victims of snakebite according to the pathology caused rather than the specific species involved. Following initial interviews, it was widely covered by national media outlets.

Dr Casewell also took part in the CBBC programme Operation Ouch! The production company filmed a venom extraction and Dr Casewell travelled to Brighton to supervise the lab work – going above and beyond to donate a vial of his own blood to test the effects of the venom! While not directly linked to the Centre, a paper published by LSTM's PhD student, Joshua Longbottom, which looks at redesigning the risk maps for snakebite across Africa was picked up by the Daily Telegraph, which featured interviews with Joshua as well as Professor Robert Harrison, the head of the Centre.

As part of the Knowledge Quarter, LSTM has signed up to be a partner in the Liverpool Business Post. During the last 12 months the paper has carried features about the opening of the Accelerator Life Sciences building, which was also featured on BBC North West TV news, the Centre for Excellence in Infectious Disease Research (CEIDR) and the opening of the Accelerator Research Clinic (ARC), run by the Experimental Pneumococcal Human Carriage Consortium. An academic paper about pneumonia causing bacteria being spread by nose picking and rubbing was published by the team at ARC and led by Dr Victoria Connor and Professor Daniela Ferreira. It gained coverage widely across the mainstream media throughout the UK and by media across the world.

LSTM Director, Professor Janet Hemingway was substantially quoted by the BBC following a paper from the Sanger Institute about what plasmodium infection in great apes can tell us about malaria in humans. She was recorded speaking prior to her appearance at the Malaria World Congress in Melbourne and appeared in a promotional video produced by Liverpool Health Partners for the International Business Festival, where she shared the stage in a panel discussion with BBC Radio 4's Professor Jim Al-Khalili and Lord O'Neill. With the Announcement of Professor Hemingway's intention to retire, she was interviewed by the Financial Times for their News Podcast talking about how we can win the war on malaria and her hopes for the future for LSTM.



Galkoff's and the Secret Life of Pembroke Place

The last 12 months has seen huge movement in relation to Galkoff's, the old Jewish butchers shop that has been part of LSTM's estate since 2012. A large grant from the Heritage Lottery fund has supported the full development of Galkoff's and the Secret Life of Pembroke Place, a project alongside National Museums Liverpool that charts the lives of many generations that lived around LSTM. The distinctive green tiled façade of the building has been removed and restored and now forms the centrepiece of an exhibition in the Museum of Liverpool. The exhibition also includes information about the last example of court housing, which is also sited partly within LSTM's estate. The project has received media attention in the last 12 months, with the court being featured in several history documentaries and Project Manager Dr Liz Stewart being interviewed by regional BBC about the arachnological dig carried out on LSTM's Oak Street car park. Stories have also been featured in the Liverpool Echo and in the Jewish print media during this time. The opening of the exhibition was also covered by BBC Radio Merseyside BBC North West Tonight and Made in Liverpool, with Professor Alister Craig being interviewed as LSTM's representative.

Estates

Estates continues to work with LSTM's education and research groups to facilitate responses to new opportunities, both in the UK and overseas by providing the full range of support in terms of estate, facilities and laboratory management health and biological safety.

Liverpool Campus


Sir Christopher Evans opens the Accelerator

The capital refurbishment programme continued throughout 2017-2018. Following the relocation of the Finance and Procurements teams, the vacated space on the ground floor of the Gilles Building has been transformed into a state of the art active learning facility comprising an active learning laboratory, collaborative learning room and a media room. Following a substantial donation of The Garfield Weston Foundation, the facility was officially opened in November.

The Liverpool Life Sciences Accelerator (LLSA) building was officially opened in March 2018 by Sir Christopher Evans OBE. Situated on Liverpool's Daulby Street, the Accelerator co-locates key researchers from LSTM and the Royal Liverpool and Broadgreen University Hospital NHS Trust (RLBUHT) along with a range of health-related SMEs and industrial partners.

Other projects included:

- The remodelling and fit out of an empty unit on the ground floor of Wolfson Building, providing office accommodation, bringing together staff from the Well Travelled Clinics, NaTHNaC and on call doctors.
- Decommissioning and refurbishment of two laboratories in a live environment, on the first floor the Mary Kingsley building, providing additional office accommodation.
- Following a detailed structural survey, option appraisal and consultation with the local planning department it had been decided not to build an additional floor on the Gilles Building. Therefore, over the summer the original roof covering, and l thermal insulation was replaced improving the thermal properties of the structure.
- Wolfson building minor works - construction additional meeting on the first floor, involving significant works in terms of the mechanical installation. Converting underutilised open plan area on the ground floor into additional office space. Installation of noise attenuating screens on the second floor.
- Supporting an archaeological excavation on the Oak Street carpark as part of the Galkoff's & Pembroke Place project.
- LLSA building - various minor works to offices and laboratories to accommodate the requirements of incoming tenants.

Heritage Works

Following careful removal and restoration by specialists, the tiles from Galkoff's now form part of the "Galkoff's and the Secret Life of Pembroke Place" exhibition, which opened at the Museum of Liverpool in October 2018. Throughout the project, Estates provided expertise to ensure the safe removal of the tiles from the site, through to the construction and installation of the exhibit at the Museum.

Malawi – Liverpool/Wellcome Trust Clinical Research Programme (MLW) campus

Estates continued to support colleague at MLW in matters relating to estates management, health and biological safety. In terms of capital projects, RIBA 2 stage proposals have been prepared for the Clinical Research Excellence And Training Open Resource (CREATOR), building. The CREATOR building is expected to accommodate a 30% increase in research activity over the next ten years, with postgraduate specialist clinical medical education. Thus, enabling a step-change in the scale of clinical research and a reversal of the accepted norm of travel outside of Malawi and the region for specialist education.

Laboratory Management and Health and Biological Safety

The Laboratory Management and Health and Biological Safety team has been modified to strengthen the support for health and safety at LSTM. The position of Head of Health and Biological Safety was created to oversee all aspects of laboratory management and health and safety. To strengthen support for Laboratory Safety the Laboratory Manager role has been made full-time and a full time Containment Laboratory Manager has also been appointed. Additionally, the role of Travel Manager has been identified to support that area of risk to LSTM staff and students who are traveling and working overseas.

Fundraising

Registered with FUNDRAISING REGULATOR

LSTM was created by the visionary industrialists who recognised the devastating impact of tropical diseases over 120 years ago. LSTM is the first institution in the world dedicated to tropical medicine research, and continues to lead today, investing in the brightest minds and the best facilities to help those who need it the most. This is reinforced by the continued support of donations, which enables LSTM's work in breaking the cycle of poor health and poverty.


Karen Brady - Director of Fundraising

Malawi Health Goals

Liverpool Football Club's official charity, LFC Foundation, and LSTM launched a joint programme in April to encourage adolescent boys in Malawi to access education and health services – to help in the fight against HIV.

Funded by the LFC Foundation, and fronted by Senegalese player Sadio Mané, the project Malawian coaches visit Liverpool, undertaking training sessions with the LFC Foundation coaches to provide them with the skills needed to deliver a range of sports sessions with youngsters back in Malawi.

LFC Foundation coaches then travelled to Malawi to work with the MLW team, running sessions in rural areas, culminating in the MLW-run Kufukufuku Science Festival in Chikwawa. Festival attendance increased from 1,500 in 2017 to 6,500, and the team engaged with more than 600 young males in footballing activities, over four sessions, which included a self-testing station.

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 and incidences are highest among 15-17-year olds. Knowledge around prevention and transmission of disease is essential amongst young people who often have low levels of awareness and are therefore more likely to contract it or be living with it unknowingly.

The project has attracted the attention of DFID, Grass Root Soccer and the Umunthu Foundation, who work with AVERT and Tackle Africa. Malawi Health Goals is due to run for another two years, including scale-up in year 2, and expansion to Lilongwe in year 3.

Comedy Fundraising Event

Comedian Daliso Chaponda performed at LSTM's first ever comedy night in September, as part of the Liverpool Comedy Festival. Born in Zambia, Daliso began his comedy career in Canada with his acclaimed one-man show Feed This Black Man. Since then he has performed around the world, was a finalist in 'Britain's Got Talent', and been commissioned by BBC Radio 4. Daliso Chaponda waived his fee in order for the proceeds from the event to be donated to LSTM's Merit Scholarships fund.

Hemingway Fellowship

As part of the celebrations of Janet Hemingway's time as Director of LSTM, a new Fellowship was announced in her name in October. Established with the support of LSTM's Trustees, Vice Presidents and friends, the new Fellowship will provide a new, competitive opportunity for a talented early-career researcher at LSTM. The Hemingway Fellowship is expected to launch in early 2019 and will form part of a significant fundraising effort to support a number of similar opportunities to attract the next generation of global health leaders to LSTM.

Weston Active Learning Lab

Thanks to the support of the Garfield Weston Foundation and other generous donors, we were able to raise funds to support the development of the new, cutting-edge teaching space, the Weston Active Learning Lab. This enables our students to get first-hand experience from experts in the field and is a critical part of LSTM's vision in developing graduates who are the leaders of the future.

Our Fundraising Priorities

We want to establish LSTM as a world-leading hub where innovation can thrive; new ideas are developed; the next generation of global health leaders are trained; and where knowledge is turned into impactful healthcare. This is not just about creating a place where new ideas can take root, but also the conditions in which more established concepts can grow and develop.

We will create a unique opportunity to bring together leading and emerging pioneers in global health research, with some of the world's most disruptive and original thinkers.

Our fundraising will support a Global Health Leadership Development Fund, marking our 125th anniversary in 2023, to enable us to redefine the questions to support new innovations in global health, support the development of new ideas from 'spark to solution' and develop the future global health workforce.

Social Mission

LSTM is proud to be a multi-cultural community which affirms the positive contributions of all its members in furthering a vision of saving lives in resource poor countries through research, education and capacity building.

Samantha Airey - Global Director of Human Resources

With LSTM's steady global growth, the work of Human Resources has never been more varied and challenging. As the organisation expands into a growing number of countries, whether that be through the engagement of a single individual or the set-up of an NGO, it continues to broaden its knowledge, expertise and global reach.

This year has also seen the retirement of Human Resources Director Christine Greenway. She was succeeded by Sam Airey as the new Global Director of Human Resources in October 2018.

Recruitment, Performance and Development

LSTM will always have a need for highly specialised expertise. To support this, it continues to broaden the use of talent pools. There has also been a growth in the introduction of new types of roles and partnerships, which often require innovative contractual arrangements. There has further been a concentration on the strengthening of the organisation's safeguarding processes.

LSTM continues to review its recruitment strategy so that it maintains its ability to attract and retain staff of the highest calibre. High performing and committed individuals and teams are crucial to LSTM's success and it continues to develop, improve and embed a performance management and development culture. As LSTM moves towards REF2021, supporting staff in their preparations for this remains a high priority within the context of organisational performance.

Advancing Equality and Diversity

By embracing diversity, LSTM hopes to promote and achieve a more rewarding environment. Building on the achievement of Bronze Athena Swan awards at both organisational and faculty level, LSTM has been focusing on delivering its consolidated action plan and is striving to achieve Silver. Initiatives include, for example, enhancement of our equality and diversity training offering, extended use of Equality Impact Assessments, focus groups examining barriers to progression, the introduction of a Line Managers' Forum, the promotion of female staff career profiles, along with enhanced networking opportunities and career support mechanisms.

Increasing numbers of staff continue to take up family friendly offerings, such as flexible working and Shared Parental Leave. More in-depth analysis of gender pay data, beyond the statutory reporting requirements allows LSTM to identify and address potential problem areas. In addition, LSTM has renewed its focus on career development support and this will continue to be a priority moving forward.

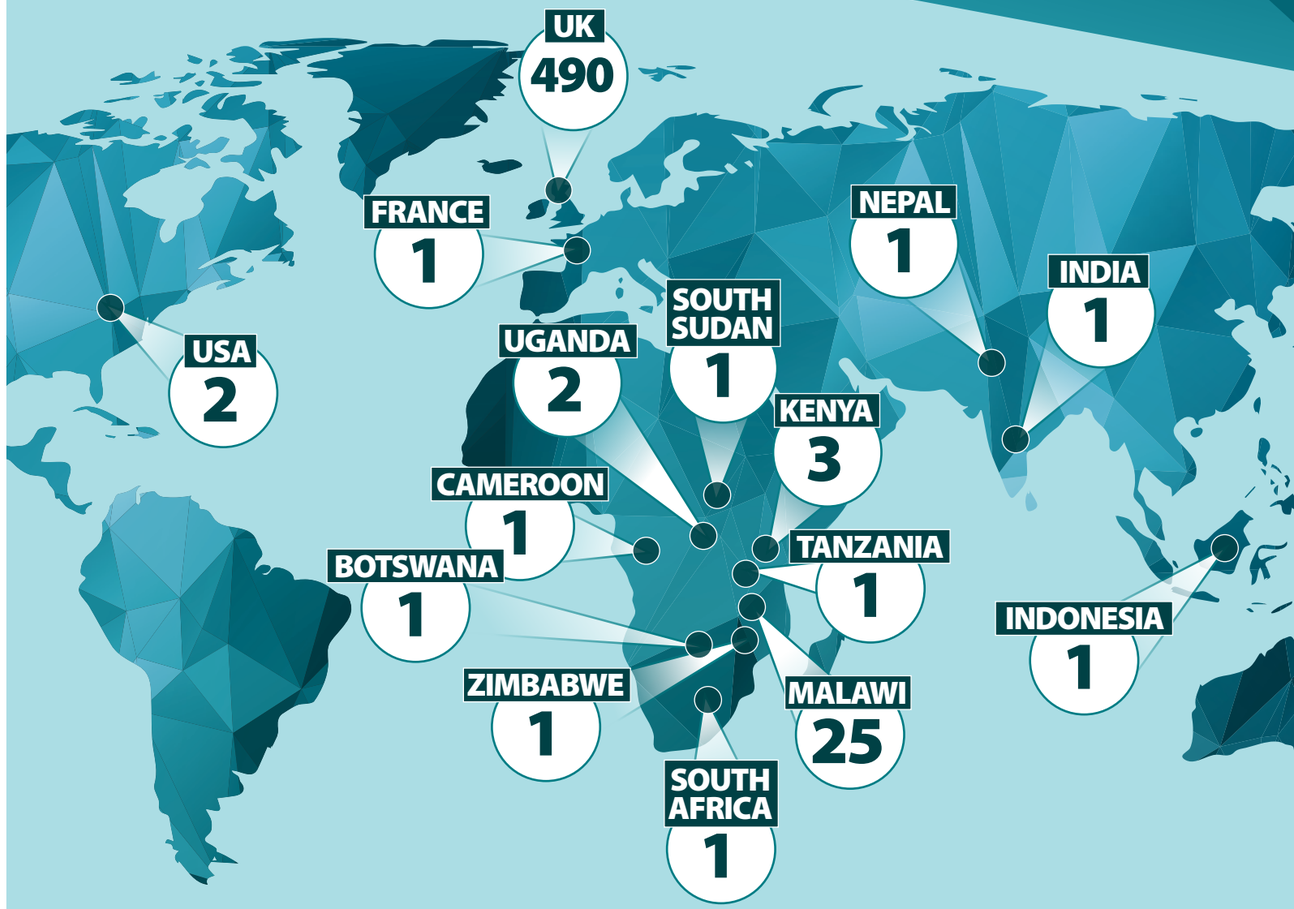
In May 2018, a group of PhD students organised LSTM's first Women in Science Symposium, celebrating the achievements of women in science and inspiring the next generation of researchers. The day was fully subscribed with around 160 delegates from LSTM and other local institutions and organisations.

Brexit

LSTM firmly remains an organisation that embraces its staff's diversity wherever they come from. To find solutions for the biggest challenges in global health it is vital that LSTM continues to be a truly global community with colleagues being selected on their academic or professional credentials rather than their place of origin. In support of this, LSTM keeps staff and students updated about the implications of Brexit as they emerge and has committed to pay the UK settlement fee for all current and future EU citizen staff members, and their potential partners, who do not have permanent resident status. In addition, we will continue to lobby relevant stakeholders to ensure the best possible outcomes for all involved post Brexit.

From left: Victoria Austin, Beatriz Carniel, Karina Mondragon-Shem, Vera Unwin, Taline Kazandjian, Aislinn Currie-Jordan, Nadia Kontogianni and Natalie Lissenden, who organised LSTM's first Women in Science Symposium

Staff Overview



490 Staff members in the UK

42 Staff members overseas on an LSTM UK contract

532 TOTAL STAFF

Numbers as per 01/09/2018

Governance

Liverpool School of Tropical Medicine was founded in 1898 and incorporated on 30 January 1905 as the Incorporated Liverpool School of Tropical Medicine. It was registered as a charity on 11 October 1963 and is a company limited by guarantee, holding no share capital and governed by a Board of Trustees.

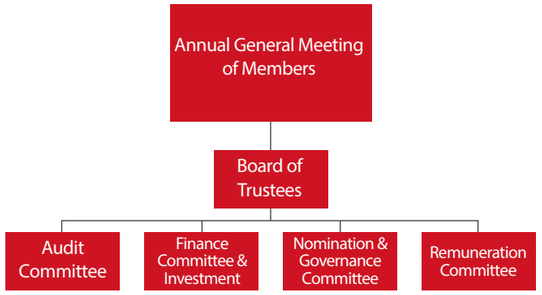
Structure, Governance and Management

LSTM's memorandum and articles of association list the main objectives as: "To engage in, promote and encourage research, study and instruction in connection with the origin, character, alleviation, prevention and cure of every or any type of tropical disease which now is or may hereafter become known in any part of the world where such disease either manifests itself or has effects; and to advance and encourage learning and the practice of all sciences and arts allied with or which may be usefully studied in connection with the matters aforesaid, and to collect and circulate information with regard to such diseases, sciences and arts."

LSTM follows the Committee of University Chairs (CUC) "The Higher Education Code of Governance" (December 2014). This enables LSTM's Board of Trustees to have the responsibility to discharge their duties with due regard to the proper conduct of public business (i.e. the Nolan Principles), ensuring and demonstrating integrity and objectivity in the transactions of their business, following a policy of openness and transparency in the dissemination of their decisions.

The Liverpool School of Tropical Medicine is a company limited by guarantee and currently has 67 members, 14 of whom make up the Board of Trustees. Members meet at the Annual General Meeting where they elect the Board of Trustees, effectively the company board of directors. It is the Board's responsibility to bring independent judgement to bear on issues of strategy, performance, resources and standards of conduct.

The Board of Trustees conducts its business through a number of formal committees. Each committee has terms of reference that have been approved by the Board.



Nominations and governance committee have the role to recruit and appoint new charity trustees, which are recommended to the Board of Trustees for approval and to appoint trustees to the formal committees.

Conduct

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.

Decision Making

The LSTM Board of Trustees must hold at least four meetings each year, but additional meetings are held as necessary. The Board has delegated the day to day management of LSTM to the Director of LSTM. In discharging these responsibilities, the Director is advised and supported by the Senior Management Group. The LSTM Board of Trustees has overall responsibility for LSTM's assets and property. Its principal responsibilities are to:

- establish a strategy and policies and plans to achieve the objectives of LSTM having regard to advice from the Director of LSTM;
- along with LSTM's accountable officer designated for these purposes, observe the terms and conditions set out in the financial memorandum for the time being in force between the Higher Education Funding Council of England/Office for Students and LSTM and establish a financial and budgetary framework within which LSTM shall operate;
- establish and oversee a framework of delegation and systems of control;
- establish policies for the assessment and management of risk and make decisions on all matters that may create significant financial risk to LSTM or which affect material issues of principle;
- monitor LSTM's performance in relation to the strategies, policies, plans, financial controls and budgets and other decisions of the Trustees;
- appoint (and if necessary remove) the Director of LSTM or other senior member of staff.

Review of Activity 2017/18

Following the decision in 2017 by the Director, Professor Janet Hemingway, to step down from her post and following a prolonged period of substantial growth, the Board of Trustees were delighted to appoint Professor David Lalloo as its new Director through unanimous decision. The search and selection processes were extensive and rigorous and Professor Lalloo has been formally appointed by the Trustees as the strongest candidate to further expand the research and teaching provision and to lead LSTM into the next chapter of its long history.

Ahead of the transition to the new Director in January 2019, the Board of Trustees reflect on the dedication and contribution from Professor Janet Hemingway, over the last 17 years, to her position at LSTM and celebrate the extraordinary growth and influence she has demonstrated as LSTM's Director and expert in the field of tropical medicine and public health. Such clarity, leadership and foresight are a rare combination and LSTM is very proud to have had Professor Hemingway as Director and congratulate her on her retirement from the Director's role.

The Board also congratulated the awarding of taught and research degree awarding powers to LSTM as a major milestone and look forward to the inaugural graduation ceremony later in 2018.

The Board welcomed the additional focus that LSTM have placed upon its procedures and processes concerning the safeguarding and protection of people in vulnerable circumstances. The Board of Trustees and Director of LSTM have clear responsibilities to ensure that the organisational culture of LSTM prioritises safeguarding and the prevention of sexual exploitation and abuse (PSEA). In March 2018, they appointed an executive lead for safeguarding, who sits on LSTM's Senior Management Group (SMG), and a designated safeguarding officer, whose role it is to develop and implement LSTM's safeguarding policies and procedures across the organisation. The Board of Trustees have approved a new safeguarding policy, code of conduct and action plan for the organisation and appointed a new strategic safeguarding oversight committee to monitor progress.

A series of safeguarding awareness raising events have been held across the organisation and new mandatory safeguarding training programme is being planned along with a new raising concerns reporting system which is being introduced in the autumn.

Board of Trustees Membership

LSTM welcomed new members to the Board of Trustees, with the appointment of Ms Eileen Thornton CBE. She trained and practiced as a chartered physiotherapist in Manchester, moved to Liverpool in 1970 to start an academic career lasting over 45 years. In 1994 she was awarded a Fellowship of the Chartered Society of Physiotherapy in recognition of the contribution made towards the development of undergraduate & postgraduate physiotherapy education. In 2012 she was awarded a Commander of the Order of the British Empire for services to Healthcare Education and Training.

Co-opted Committee Members

The Board of Trustees recognise the contribution of our co-opted members to the working governance arrangement of LSTM's committee structure. These individuals bring independent expertise from the sector and provide outstanding contribution and support to the Board of Trustees in discharging its responsibilities. The Board extend special thanks to both Sheila Fowler for her 15 years' service to the Audit Committee and Nabela Chaudhry for her 9 years' service to the Finance and Investment Committee, as they both step down from their roles in the Autumn of 2018. The Board also wish to thank Dr Jon Beck and Mr Andy Chittenden who are co-opted members on Audit Committee and Joanne Dodd, who is the co-opted member of the Finance and Investment Committee.

Finally, the Board of Trustees pay particular thanks to Lord McColl VP, who has retired following 10 years' service and for the unstinting support he has provided to LSTM.

Officers 2017/18

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PRESIDENT
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CHAIRMAN
James Ross OBE

DIRECTOR
Professor Janet Hemingway CBE FRS DSc PhD BSc NAS (Foreign Associate) FMedSci FRCP (Hon) FRES (Hon) FAAM Hon FFPH

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Sir Arnold Burgen FRCP FRS
Baroness Cox of Queensbury FRCN
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Jesper Kjaedegaard
The Rt Hon The Lord McColl of Dulwich Retired March 2018
Stephen Mogford
Dame Lorna Muirhead DBE
Dame Jane Newell DBE JP
The Rt Hon Sir Stephen O'Brien PC KBE
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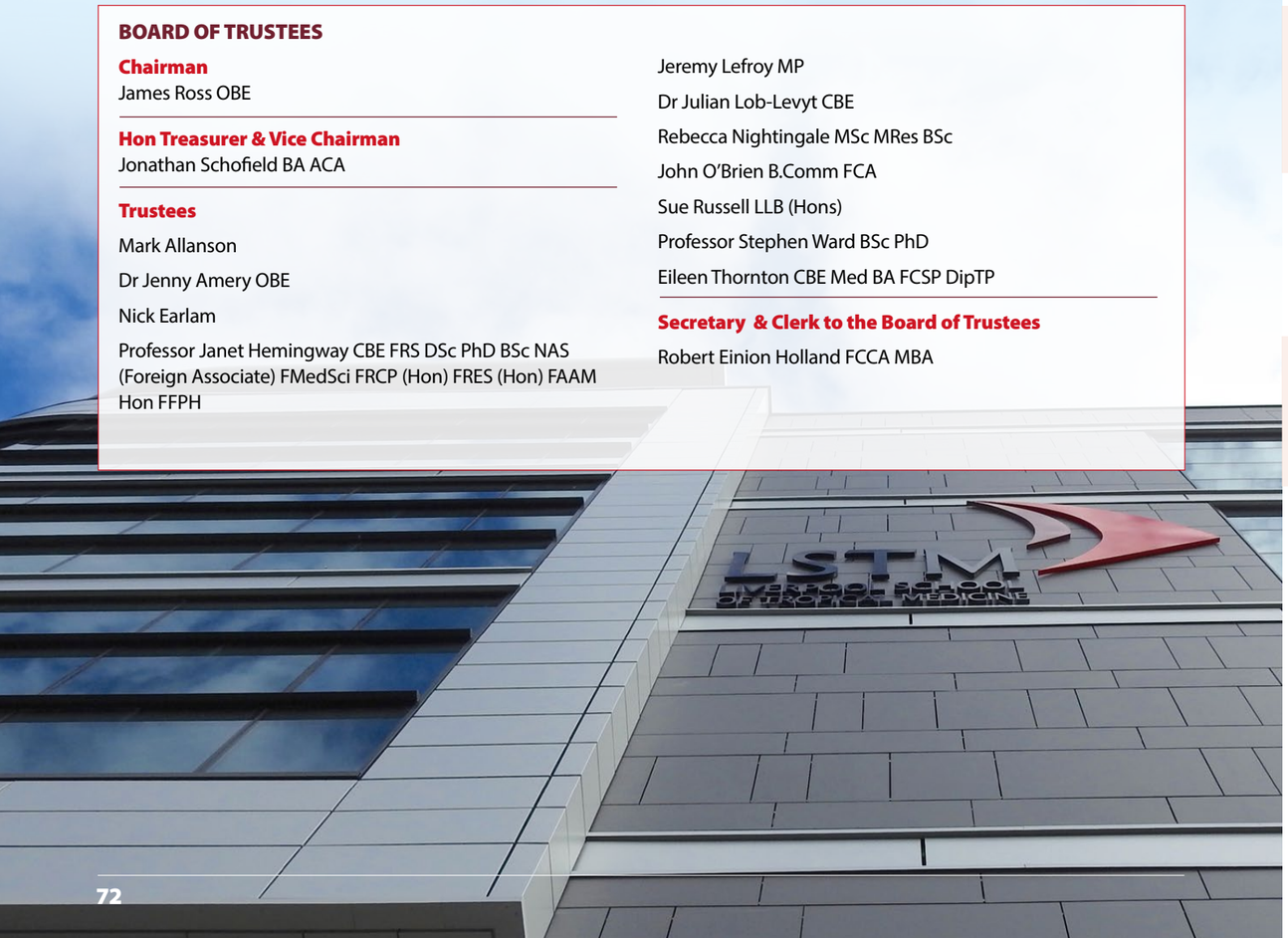
Eileen Thornton CBE Med BA FCSP DipTP

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



Awards and Honours

In November 2017, LSTM's Senior Professorial Fellow David Molyneux was awarded the Dr Dominique Kylelem Prize at the COR-NTD annual meeting in Baltimore, together with Dr Mwele Malecela from Tanzania. Given annually in memory of Dr Kyelem, who gained his PhD under the supervision of Professor Molyneux, and is awarded for outstanding contribution in the field of NTDs.

LSTM PhD student Ashwaq Alnazawi won best abstract at the 2nd Gulf Congress of Clinical Microbiology and Infectious Diseases in November 2017. She won her prize for her abstract on 'Discovery of the novel mutations in the voltage sodium channel of Aedes aegypti from dengue endemic regions in the Kingdom of Saudi Arabia.'


Ashwaq Alnazawi

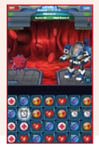
In March 2018, LSTM's Director Professor Janet Hemingway was awarded the London School of Hygiene & Tropical Medicine's Honorary Fellowship in recognition of her outstanding contributions in Global Health.


Professor Janet Hemingway (left)

Also, in March, LSTM's Dr Samantha Donnellan received a prestigious Winston Churchill Fellowship. I It is awarded to UK citizens to enable them to travel overseas in pursuit of new and better ways to tackle challenges facing the UK. Dr Donnellan used hers to travel to the Universities of Cape Town and Harvard to further her work on multi-drug resistant TB.

Dr Helen Nabwere, from LSTM's Centre for Maternal and Newborn Health (CMNH), was awarded the prize for the best poster at the Royal College of Paediatrics and Child Health held in March. Her winning poster presented preliminary results from research she led on assessing the use of continuous positive airway pressure in newborn care in Kenya.

Later in March the Engaging Tools for Communication in Health team won the Innovation in Apps and Gaming Award at the ISNTD Festival for Resistance 101 and Battle in the Blood.



CMNH's Dr Mary McCauley won three prizes in from the Royal College of Gynaecologists in April for her ongoing work and research to improve maternal health in low-and-middle-income countries. She was awarded the John Lawson Prize for a paper looking at healthcare providers' awareness and attitudes to pain relief during labour in Ethiopia; she was awarded second place for the Harold Malkin Prize for a Cochrane Review look at vitamin A supplements in pregnancy and was also awarded the EGA Hospital Travelling Fellowship to facilitate travel to Zimbabwe to carry out research improving the health of HIV positive women after childbirth.

Dr Nicodem Govella, who carried out his PhD under LSTM's Dr Gerry Killeen, was honoured by the British Council in April as an outstanding Alumni of a UK University. Dr Govella carried out his PhD research in Tanzania at the Ifakara Health Institute.

In May the Business of Science Conference, held this year in Liverpool, awarded its Special Recognition Award to LSTM's Director, Professor Janet Hemingway, saying: "There are 7 million children alive today who wouldn't be, were it not for the hard work of the LSTM team, this is recognition of the hard work."

In June, Dr Rachael Milligan was awarded the Best on Brightspace Award by LSTM's TEL Team after students voted her module, TROP973 Systematic Review for Policy and Practice the best on the platform for its "beautiful and simple organisation" making its navigation straightforward and informative for post teaching refection and assignments.

Professor Philip Padfield, LSTM's Dean of Education was awarded the status of Principal Fellow by the Higher Education Academy (HEA) in June. As the most senior level of fellowship from the HEA, it reflects the fact that Professor Padfield is able to demonstrate a sustained record of strategic leadership in academic practice and development.

In September Dr Grant Hughes was recipient of a Royal Society Wolfson Fellowship as one of the schemes eight inaugural fellows. It aims to support UK universities and research institutions to recruit and retain outstanding senior research scientists, particularly those from outside the UK.

September also saw the announcement of the winners in the Neglected Tropical Disease NGO Network and Royal Society of Tropical Medicine and Hygiene's BEAT NTDs photo competition, with LSTM MSc student Zikmund Bartoníček taking joint first prize and Honorary Research Fellow Michelle Stanton being among the 10 finalists.

Also in September, Professor David Molyneux was awarded the Mary Kingsley Medal, which is LSTM's highest honour.

November 2018 saw LSTM's Dr Shevin Jacob receive a Public Health Leadership Award from the Harvard Alumni Association, in recognition of his contribution to public health internationally through his work on sepsis, Ebola and other infectious diseases.


Dr Shevin Jacob

Also in November, LSTM's Duncan Preston won the Finance Director of the Year Award 2018, which celebrates the achievements of leading individuals and businesses within the Liverpool City Region, Cheshire and North Wales regions.

Lectures and Seminars

LSTM's Seminar Series continued in 2018 with a wide range of external and internal speakers. The Series, which runs for three months during each semester, is supported by LSTM's Research Committee. 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 and students and external audiences via the live stream and recording provided.

External speakers included BMJ's investigations editor Deborah Cohen on 'Investigative journalism in global infectious diseases research'. She presented various cases she has been working on which led to her being shortlisted for science and health journalist of the year for the 2018 British Journalism Awards.

Another popular seminar was given by the Director of Sense about Science, Tracey Brown OBE, on 'Evidence and Expertise: we don't live in a post-truth society and here's why'. Her organisation has launched important initiatives including AllTrials, a global campaign for the reporting of all clinical trial outcomes; and the Ask for Evidence campaign, which engages the public in requesting evidence for claims. In 2010, the Times named Tracey Brown as one of the ten most influential figures in science policy in Britain and in 2014 she was recognised by the Science Council for her work on evidence-based policy making.

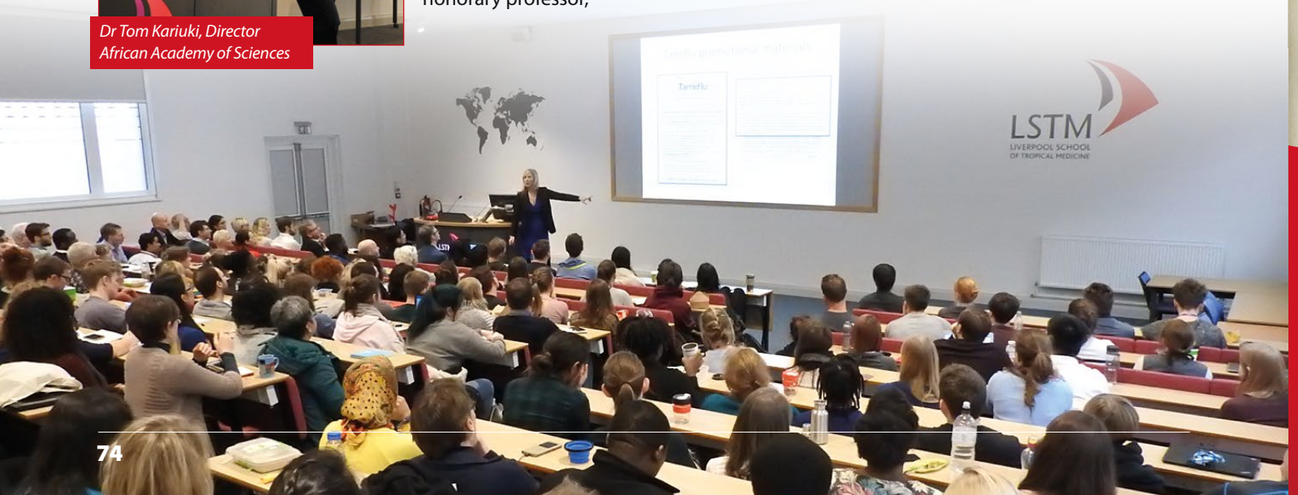
Dr Tom Kariuki, Director African Academy of Sciences

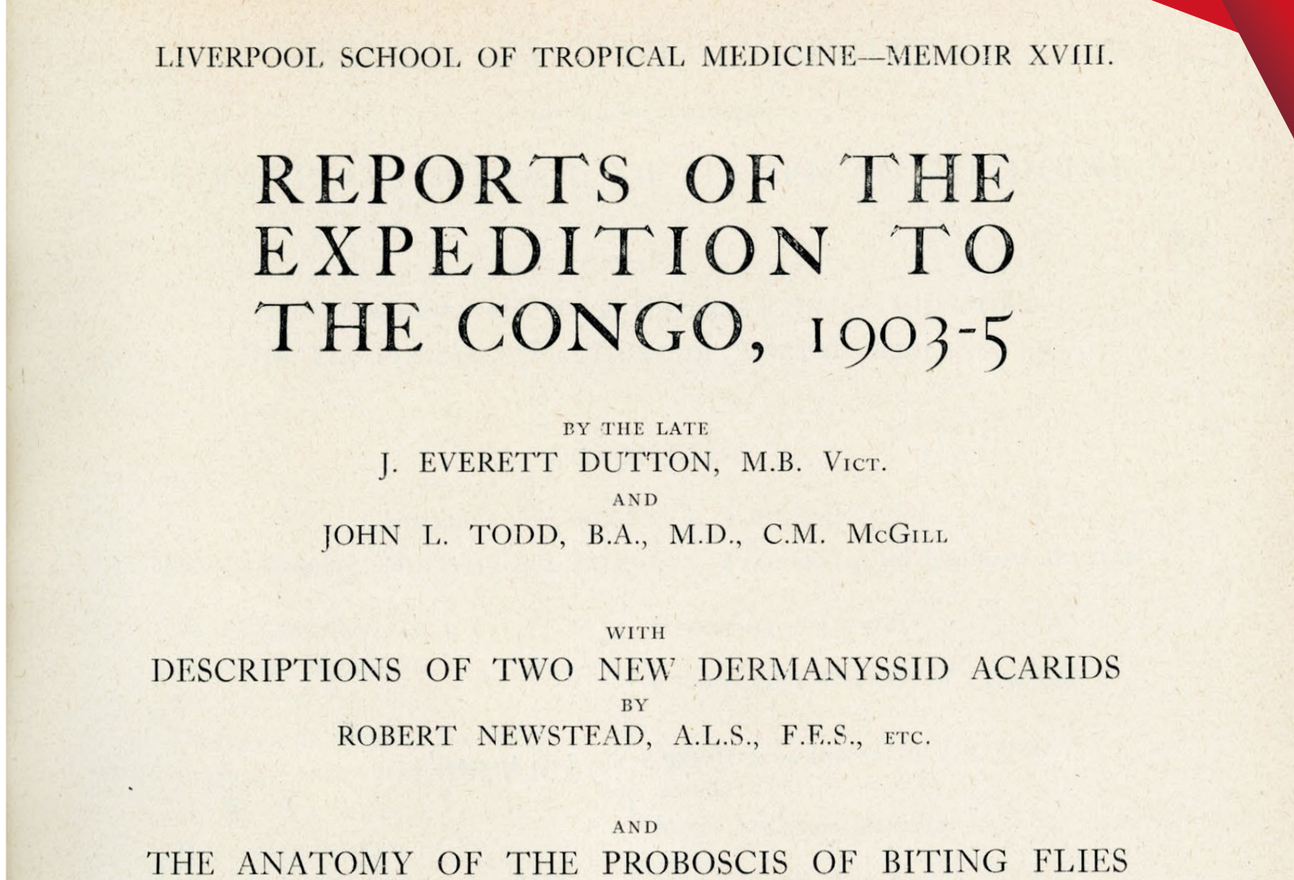
Dr Tom Kariuki, Director of the African Academy of Sciences and LSTM honorary professor, gave a seminar on his Academy's efforts to accelerate world-class research, foster innovation and promote scientific leadership on the continent and highlight grants opportunities, such as Grand Challenges Africa and the new researcher mobility funds.

The Rt Hon Nick Herbert MP gave a seminar in his capacity as co-chair of the All Party Parliamentary Group on Global TB and how to accelerate the progress towards the ending of the global TB epidemic. He praised LSTM's (research) role in the fight against tuberculosis.

A number of LSTM speakers gave a seminar on topics that illustrate LSTM's research impact (see also impact case studies elsewhere in this report). Dr Penelope Phillips-Howard described the menstrual health (MH) challenges that girls in low and middle-income countries face, which impact on girls' schooling, psycho-social, and sexual and reproductive health. Dr Justin Pulford on research capacity strengthening in low and middle-income countries and Professor Nynke van den Broek on Infections during and after pregnancy.

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





LIVERPOOL SCHOOL OF TROPICAL MEDICINE—MEMOIR XVIII.

REPORTS OF THE EXPEDITION TO THE CONGO, 1903-5

BY THE LATE
J. EVERETT DUTTON, M.B. VICT.
AND
JOHN L. TODD, B.A., M.D., C.M. McGILL

WITH
DESCRIPTIONS OF TWO NEW DERMANYSSID ACARIDS
BY
ROBERT NEWSTEAD, A.L.S., F.E.S., ETC.

AND
THE ANATOMY OF THE PROBOSCIS OF BITING FLIES
BY
J. W. W. STEPHENS, M.D. CANTAB.
AND
ROBERT NEWSTEAD, A.L.S., F.E.S., ETC.

MARCH, 1906

PRICE 7/6 Nett

PUBLISHED FOR THE
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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

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

EHCRC
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

IMPPACT
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/imppact

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

ReBUILD
Exploring approaches to health system development in conflict affected countries in Africa and Asia.
Funded by: UK Department for International Development
Web address: www.rebuildconsortium.com

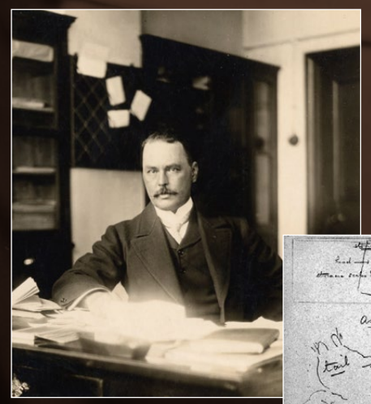
Tropical Infectious Diseases Consortium
A collaboration between LSTM, the London School of Hygiene and Tropical Medicine (LSHTM), the Jenner Institute at Oxford University and Public Health England, managing the MRC Confidence in Concept funding for individual projects that accelerate the transition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

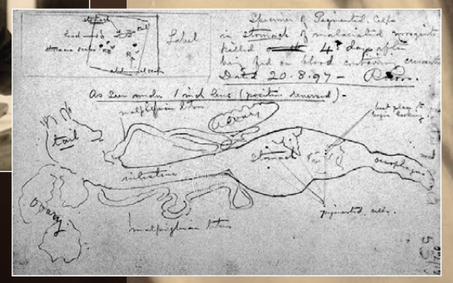
LSTM Pioneers

Sir Ronald Ross KCB KCMG FRS FRCS (1857 – 1932)

Medical doctor Ronald Ross is widely known as the first British Nobel laureate. He received the Nobel Prize for Medicine in 1902 for, as the Nobel Committee put it, "…his work on malaria, by which he has shown how it enters the organism and thereby has laid the foundation for successful research on this disease and methods of combating it."

He made his discovery during his work in the Indian Medical Service. Ross' scribbles on paper are from 1897 and show the dissection of a malariated mosquito. It was LSTM's first Dean, Professor Rubert Boyce FRS, who managed to recruit Ronald Ross to become LSTM's first lecturer in 1899. He held various senior positions with LSTM and was knighted in 1911. As of 1917 he held various positions with London based research institutions and hospitals.





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.

This statement has been included in compliance with the formal reporting requirement introduced by HEFCE as the principal regulator of English Higher Education Institutions. 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 are published throughout this Annual Report.

Editorial team: Clare Bebb; Diderik van Halsema (coordination)

Contributors: Clare Bebb; Daniel Bennett; Giancarlo Biagini; Karen Brady; Kelly Byrne; Maxine Caws; Joan Fahy; Nick Feasey; Tom Fletcher; Kevin Francis; Paul Garner; Geoff Gill; Nick Goldup; Diderik van Halsema; Nick Hamon; Jenny Hill; Shevin Jacob; Shabbar Jaffar; Chris Jones; Jayne Jones; Wanjiku Kagima; Peter MacPherson; Tim Martineau; David Molyneux; Kevin Mortimer; Angela Obasi; Phil Padfield; Meg Parkes; Penelope Phillips-Howard; Hilary Ranson; Adam Roberts; Martina Savio; Bertie Squire; Victoria Sennett; Miriam Taegtmeyer; Mark Taylor; Joanne Thomas; Phil Tubb; Elly Wallis; Helen Williams; Elli Wright; Helen Williams

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Contact Us

Liverpool School of Tropical Medicine, Pembroke Place, Liverpool, L3 5QA, UK

t. +44 (0)151 705 3100 **f.** +44 (0)151 705 3370 **e.** info@lstmed.ac.uk

Company registration number: **83405**

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