Institution: London School of Hygiene & Tropical Medicine (LSHTM)
Unit of Assessment: UoA2 – Public Health, Health Services & Primary Care
a. Overview

LSHTM is one of the world's leading schools of public health, strongly focused on research for the prevention and control of high-burden diseases. In 2013 we topped the table of the world's leading research-focused graduate schools in the *Times Higher Education* World University Rankings. We are one of the UK's most research-intensive higher education institutions (HEIs): HESA data show our research income per FTE (£125Kpa) is the highest in the UK, almost twice that of the next placed HEI; and in 2012/2013 63% of our total income was for research. We are in the first three HEIs in the UK (first five in the world) for the proportion of our publications in the top 10% most frequently cited, and we have one of the most extensive collaboration networks of any university globally (Leiden Ranking 2013).

The 257.16 FTEs submitted in UoA2 (82% of our REF submission) is a 44% increase from 2008 when we submitted 179 FTEs to RAE UoA6 and UoA7. Over the REF period, our staff associated with UoA2 were awarded £288m for research and published over 5980 peer-reviewed papers. We have strengthened research leadership in priority areas through internal and external appointments to senior positions and strongly supported the growth and development of our early career researchers. Major physical redevelopment and support services reorganisation has improved the working environment. We have adopted a more strategic approach to partnerships, leading to strengthened collaborations in the UK and overseas.

Our UoA2 submission includes all staff from the four departments in the Faculty of Epidemiology and Population Health (EPH) and the three departments in the Faculty of Public Health and Policy (PHP), together with most staff of the Department of Disease Control and around half of the staff of the Department of Clinical Research in the Faculty of Infectious and Tropical Diseases (ITD). Departments are the 'home' of academic staff, where technical and administrative support is provided for research, doctoral training and career development. Research activity is centred on flexible and dynamic research groups, which often span departments and faculties, developing and evolving over time in response to research priorities and opportunities.

Our research is predominantly multidisciplinary and collaborative, including collaboration with clinical and laboratory-based researchers returned to UoA1, the School's other submission. Disciplinary expertise crosses the three faculties, facilitating collaborative working. Epidemiological and statistical expertise is concentrated in EPH, with close links to the epidemiologists and statisticians in other faculties. PHP houses most of the School's social scientists, who work across faculties, contributing both disciplinary and policy expertise. Clinically qualified staff work in all three faculties, and many of the infectious disease clinicians are in ITD working with vector biologists and infectious disease control experts.

Our School Centres, a formal matrix structure across faculties that supports multidisciplinary and cross-departmental research in areas of strategic importance, have been given much greater emphasis in recent years. Each Centre brings together researchers, doctoral students and key external partners to develop research, foster collaboration and interact with policy-makers, research funders and the general public.

All our 13 Centres are relevant to UoA2. Three predate the assessment period: the Malaria Centre, the Centre for History in Public Health and the European Centre on Health of Societies in Transition (ECOHOST). Ten have been established since 2008: Centres for Global Non-communicable Diseases (NCDs), Tuberculosis (TB), Maternal, Adolescent, Reproductive and Child Health (MARCH), Evaluation, Mathematical Modelling of Infectious Diseases, Statistical Methodology, the International Diagnostics Centre and the International Centre for Evidence in Disability, along with two Centres joint with other London HEIs – the Centre for Global Mental Health (with King's) and the Bloomsbury Centre for Genetic Epidemiology and Statistics (with UCL and Birkbeck). To foster multidisciplinary and multisectoral research, we join with four neighbouring colleges in the London International Development Centre (LIDC). Finally, the Bloomsbury Research Institute with UCL, involving UoA1 pathogen researchers, is also a critical multidisciplinary partner for UoA2 researchers.

b. Research strategy

In 2010 we appointed a new Director, Professor Peter Piot, and in 2011 a new Vice Director, Professor Anne Mills FRS. They led the development of a new School Strategy for 2012–2017, combining staff insights with those from our international collaborators and a visiting committee of world-leading experts. The Strategy provides the framework for central investment decisions and priority-setting, with research initiatives encouraged and taken forward within faculties and centres. Strategy implementation is overseen by the Senior Leadership Team and by Council, the School's governing body; they also monitor significant external developments that could lead to new opportunities and strategic directions.

The new Strategy responds to changing global health priorities. NCDs are growing causes of morbidity and mortality, though unacceptable burdens and risks of infectious diseases persist. Sustainable development is emerging as a key theme, with responses needed across sectors such as nutrition, education and the environment, and within the health sector, to strengthen access to quality health care. The traditional paradigm of the rich world solving the problems of the poor is outdated, with much greater global interdependence, dispersed expertise and pluralism in problem definition and solutions. In Europe, the increasing burden from NCDs as life expectancy rises coincides with countries having to cope with no increase in real terms of funding for health care systems after a period of spending growth. Pressing issues include how to improve the quality of health services and public health provision on a constrained budget.

The School Strategy sets out research priorities that respond to these trends. These follow on from, and are consistent with, those we set out in RAE UoA6 and UoA7. The objectives are:

- to be a world-leading centre of excellence for research into high-burden health problems and the interventions and systems of delivery needed to respond to them
- to develop and evaluate new tools and methods for health improvement
- to understand, evaluate and improve the performance of health services and systems across the world
- to understand influences on health of other sectors, and evaluate policy options and implications.

Below we highlight some of our major discoveries and innovations during the assessment period in each of these four areas. For reasons of space, only staff leading the research teams are noted. We also outline key elements of our future plans. Concluding this section is a summary of the characteristics of our research environment which are critical to our past and future successes.

Increased knowledge relating to high-burden health problems

Malaria *(Behrens, Chandromohan, Floyd, Greenwood, Hanson, Kleinschmidt, Logan, Milligan, Mills, Rowland, Staedke, Schellenberg D, Webster, Whitty, Wiseman, Yeung)*

- We demonstrated that intermittent preventive treatment of malaria in African infants can reduce clinical malaria by 30% and anaemia by 21% in the first year of life, and also developed and proved the effectiveness of seasonal malaria chemoprevention, a new approach to protecting West African children.
- We are part of the partnership conducting the first phase 3 trial of a malaria vaccine (RTS,S/AS01), likely to become the first licensed.
- Through our leading involvement in the Innovative Vector Control Consortium and the Pan-African Malaria Vector Research Consortium, we developed and evaluated three new long-lasting insecticides for house spraying and two new mosquito bed-net insecticides.
- Our future malaria control research agenda reflects two major themes: the threat posed by drug and insecticide resistance, and tools needed to pursue malaria elimination. We will combine findings from the 16 studies in the Gates Foundation-funded ACT Consortium to address how to optimise the uptake of artemisinin-based combination therapy (ACT) in Africa and Asia, and evaluate new combination interventions against parasite and vector.

HIV *(Corbett, Foss, Glynn, Godfrey-Faussett, Hayes, Jaffar, Kapiga, Rhodes, Ross, Timaeus, Todd, Watts, Weiss, Weatherburn, Zaba)*

- Our analysis of observational data from 1989 to 2012 from six large African demographic surveillance sites showed that pregnancy-related mortality among HIV-infected women is eight times higher than in uninfected women.
- We demonstrated in Uganda that home-based care can improve equitable access to HIV treatment in resource-poor settings and reduce costs, and in Malawi that self-testing for HIV is both acceptable and accurate.
- We played a leading role in a multi-centre phase 3 trial of a microbicide gel (MDP301), showing that while it was safe, there was no evidence of a protective effect against HIV.
- Future research will: measure the impact on HIV incidence at population level of universal test-and-treat in South Africa and Zambia; test the safety and acceptability of a new disposable device for infant male circumcision; study interventions to increase uptake of male circumcision; evaluate the impact of human papillomavirus (HPV) vaccination on HIV incidence in girls and young women.

TB *(Fielding, Godfrey-Fausset, Hayes, Moore, Porter, Vassall, White)*

- In a trial in 24 communities (>1m people) in Zambia and South Africa, we showed that a novel intervention to promote testing and care for TB and HIV in households has potential to reduce TB transmission within the community.
- We showed, in large molecular epidemiology studies in Malawi and elsewhere, that HIV increases TB risk due to recent infection more than that due to reactivation of past infection.
- We showed the key importance of lifestyle factors (e.g. smoking), social and structural determinants on TB burden in studies in Brazil, Zambia and elsewhere.
- Future research will focus on integrating TB and HIV strategies, evaluating new diagnostics and using improved understanding of where and how transmission occurs to design control strategies.

Eye disease *(Bailey, Bowman, Foster, Gilbert, Solomon)*

- We demonstrated in Tanzania that active trachoma can be eliminated with a single round of treatment and undertook large-scale clinical trials of eyelid surgery in Ethiopia.

- We developed a low-cost rapid survey methodology and compiled global data on the epidemiology of visual impairment and blindness in adults and children.
- In research on retinopathy in premature babies we identified weaknesses in neonatal service delivery in various countries including Brazil, and tested ways to improve outcomes.
- We will: continue to study the epidemiology of visual impairments and disability in adults and children; research simple and more complex interventions for disabling impairments; and investigate appropriate technology and innovative interventions for control of non-communicable eye diseases (diabetic retinopathy, glaucoma).

Maternal, reproductive, sexual and child health *(Campbell, Cousens, Filippi, Lawn, Kirkwood, Marchant, Marston, Mayhew, Mills, Ronsmans, Schellenberg J, Vassall, Wellings)*

- In support of the Millennium Development Goals (MDGs), we contributed to: new epidemiological estimates and systematic literature reviews on interventions to reduce maternal and child mortality; new methods for tracking donor funding; and the first-ever UN estimates for preterm birth and stillbirth rates and deaths on the first day of life.
- We showed in Tanzania that the bivalent HPV vaccine is safe and immunogenic, and demonstrated that vaccinating in primary schools can achieve high coverage rates.
- We found that integration of HIV and reproductive health services in Kenya, Malawi and Swaziland can lead to better health outcomes and service experience, decreased stigma and cost savings.
- We co-led (with UCL) the third National (UK) Survey of Sexual Attitudes and Lifestyles.
- The MARCH Centre will focus on three research priorities: the health needs of adolescents (a neglected group); interventions to reduce the world's 2.6m stillbirths and 3m neonatal deaths per year, including evaluating strategies to improve maternal and neonatal health in Africa and Asia; and improving child health and development, including reducing disability.

NCDs and injuries *(Casas, Coleman, De Stavola, Dos Santos Silva, Doyle, Ebrahim, Edwards, Fletcher A, Kinra, Leon, McCambridge, McKee, Nitsch, Pearce, Perel, Peto, Pocock, Rachet, Roberts, Shakur, Smeeth)*

- Key findings from our various global networks include: socioeconomic differences in cancer survival occur soon after diagnosis, regardless of prognosis (CONCORD); increased adiposity in rural-to-urban Indian migrants occurs more rapidly than changes in other metabolic risk factors and is greater in lower socioeconomic groups (SANCD/Indian Migration Study); global patterns of asthma prevalence are not related to allergen exposure and non-allergic asthma is particularly important in poor countries (ISAAC, SCAALA).
- We conducted genome-wide association studies on breast cancer, pre-eclampsia, schizophrenia and trachoma, and confirmed genetic risks for age-related macular degeneration and type-2 diabetes in Indian cohorts; we pioneered the use of genetics for drug target validation.
- We led the CRASH-2 study, a large randomised placebo-controlled trial in 274 hospitals in 40 countries of trauma patients, which showed that a very low-cost drug, tranexamic acid, reduces the chance of death from severe blood loss by one third and is highly cost-effective.
- Our global NCD research will expand significantly. We will: implement in sub-Saharan Africa a multi-country study of breast cancer and establish DNA biobanks; elucidate the molecular basis of cardiometabolic and psychiatric diseases using metabolomic and epigenetic approaches; develop approaches for stratified medicine including genetic data from the UK Biobank and the Clinical Practice Research Database; investigate why Russia has the highest cardiovascular mortality in the world; evaluate a mobile phone application which supports management of high

blood pressure, diabetes, problem drinking and depression in India; further explore infectious disease and NCD links; and expand neuro-epidemiological research.

Mental health *(Cohen, Kirkwood, Patel, de Silva, Weiss)*

- Through epidemiological studies and systematic reviews on the global burden of mental disorders we brought global attention to this historically neglected field; we co-chaired the Grand Challenges in Global Mental Health initiative which defined research priorities.
- In controlled trials we demonstrated that community health workers can successfully deliver interventions for depression, anxiety and schizophrenia in low-resource settings.
- We plan to pursue epidemiological and intervention research for a wider range of mental health problems (e.g. child mental disorders and substance use disorders) and explore their links to other public health priorities (e.g. HIV/AIDS and NCDs). We will build on our current global partnerships and establish a network for policy- and practice-relevant mental health research.

Nutrition *(Dangour, Ferguson, Filteau, Lock, Prentice, Uauy)*

- The MRC International Nutrition Group showed that: early life nutrition affects thymic development, immune function and survival; peri-conceptional nutrient supply to mothers affects the epigenetic patterns of meta-stable epialleles; pre-conception multi-micronutrient supplements have widespread impact on the epigenome of offspring; and host genetic factors modifying iron homeostasis affect pathogenesis of HIV, TB and malaria.
- In Cochrane reviews we found no direct evidence of a protective effect of omega-3 long-chain polyunsaturated fatty acids against dementia nor any health effects of eating organically produced food.
- Building on past discoveries, we will conduct nutrition research on: hormonal mediators of growth failure in young children; consequences of maternal HIV exposure on HIV-uninfected children; the host-pathogen battle for iron; phenotypic consequences of early epigenome modification; interventions to optimise the methyl donor metabolome in mothers; and the effect of antiretroviral therapy on HIV-infected malnourished adults.

Development of new tools and methods for health improvement

Vaccines *(Edmunds, Fine, Greenwood, Griffiths, Jit, Mangtani, Milligan, Mounier-Jack, Mulholland, Rodrigues, Sanderson, Scott, Smith P, Smith R)*

- Through the MenAfriCar consortium, we demonstrated in Chad that the new vaccine against serogroup A meningococcal meningitis reduced the incidence of all types of meningitis by 94%, no cases of serogroup A were detected in the vaccinated regions and carriage was dramatically reduced.
- In Kenya, adding a 10-valent pneumococcal conjugate vaccine to the infant immunisation schedule, and a catch-up campaign for children under 5, resulted in the first year in a 57% reduction in all invasive pneumococcal disease; subsequent surveillance showed the virtual elimination of invasive pneumococcal disease caused by the vaccine's serotypes.
- Findings from multidisciplinary mathematical models and economic analyses demonstrated cost-effectiveness and changed UK policy on rotavirus, HPV, herpes zoster and influenza vaccines, and low-income country policy on Hib, pneumococcal and rotavirus vaccines.
- We will: establish a vaccines centre to develop and coordinate our research and consolidate links with Public Health England, the Department of Health (DH), WHO and GAVI; through our partnership with the Farr Institute, interrogate UK electronic health records to evaluate disease burden, vaccine coverage and effectiveness of new policies (e.g. Zoster vaccine for 70–79-year-olds); with the Programme for Appropriate Technology in Health (PATH), advance the

clinical development in Kenya and Indonesia of an inexpensive whole cell pneumococcal vaccine.

Diagnostics *(Corbett, Moore, Peeling, Vassall, Whitty)*

- We developed a point-of-care diagnostic test for cryptococcal meningitis and showed in South Africa that a screen-and-treat strategy was effective in preventing the many cases that present after a diagnosis of HIV infection.
- We showed it is feasible and cost-effective to introduce new point-of-care tests for syphilis in prenatal clinics in a variety of settings in Africa, Asia and South America.
- We will: expand our diagnostics research, supported by our new International Diagnostics Centre, encompassing discovery of novel biomarkers (e.g. for leishmaniasis and African trypanosomiasis), working with test developers and authorities to develop target product profiles, establishing a network of sites collaborating on test development, and evaluating new tests.

Statistical, modelling, and evaluation methodology *(Altmann, Armstrong, Carpenter, Chalabi, Cummins, Dudbridge, Edmunds, De Stavola, Elbourne, Evans, Frost, Green, Grieve, Hargreaves, Kenward, Mays, Nitsch, Petticrew, Ploubidis, Pocock, Rachet, Sanderson, Wang)*

- We developed tools for multiple imputation of missing values, culminating in a book published by Wiley, and developed the method of distributed lag non-linear models for delayed and non-linear associations with time series data.
- We extended a multivariate matching method, genetic matching, and developed new multilevel models for cost-effectiveness analysis using data from cluster randomised trials.
- We contributed to modelling the spread of H1N1 pandemic influenza, and published one of only two real-time assessments of the epidemic, and the first real-time economic analysis.
- Among our methodological innovations in evaluation at intervention, programme and systems levels were: systematic reviews of evidence from diverse study designs; evaluation of complex interventions such as those addressing social and structural determinants of health; evaluation of health benefits from interventions in other sectors, such as those from free bus travel for young people in London; evaluation of development programmes such as the global subsidy for artemisinin-based combination therapy for malaria.
- Our future plans include: developing methods to use computerised data to improve patient care and public health (through our partnership in the new Farr Institute); further work on causal inference, missing data, time-series analysis and phylogenetic analysis; supporting and promoting innovative evaluations by further developing our Centre for Evaluation.

Performance of health services and systems

Health services research *(Black, Cairns, Cromwell, Gorsky, Green, Grieve, Hogan, Miners, Sanderson, van der Meulen)*

- Methodological research on the use of patient reported outcome measures (PROMs) for comparison of providers demonstrated: the influence of recruitment and response biases; the interrelationship between measures of symptoms/function, quality of life and complications; the impact of choice of metric on the detection of outlier providers; and the best ways of presenting results to clinicians and the public.
- A retrospective case record review of hospital care – the largest ever conducted in England – concluded that the best estimate of the number of avoidable hospital deaths is about 12,000 a year rather than previous claims of 40,000.

- Methodological research on the use of administrative data for comparing clinical practice and outcomes across providers demonstrated: the influence of coding completeness on the accuracy of data describing surgical practice and postoperative outcomes; the use of linked clinical and administrative data to assess data accuracy; the use of multiple imputation to derive risk-adjusted outcomes when there is missing data on patient characteristics.
- Our economists completed important cost-effectiveness studies in the areas of vaccines, diagnostics, and maternal and child health.
- Our future priorities for health services research include developing PROMs for use in assessing dementia services; linking clinical and routine datasets to provide improved indicators of the quality of surgical care; developing the routine use of avoidable hospital deaths as a key metric of safety for the NHS; investigating the detection of and improving the management of the 'deteriorating patient' in hospital wards.

Health policy and systems research *(Allen, Balabanova, Berridge, Borghi, Coker, Erens, Gilson, Goodman, Hanson, Lee, Mayhew, Mays, McKee, Mills, Parkhurst, Smith R)*

- A programme of research on reforms to the English NHS found that the 2003–2010 Labour reforms generated stronger incentives for quality and efficiency than those in the 1990s with no obvious detriment to equity of access; research on contracting in England showed financial risk is often not allocated according to formal contractual provisions; and monitoring of quality of care by commissioners is difficult to achieve but essential for the quasi-market to function well.
- Our repeat of the 1985 study 'Good Health at Low Cost' provided fresh insights into the importance of effective institutions, innovation and country leadership in catalysing health improvements in low-income countries.
- We applied policy analytical theory to improve understanding of the political and organisational forces influencing health policy implementation across a range of issues in various African settings (e.g. integrated management of childhood illness in Kenya and Tanzania, antiretroviral roll-out in South Africa, adoption of new vaccines in five countries).
- Through our DH-funded Policy Research Units we will evaluate government reforms and local public health and health services at a time of major change. Within the School for Public Health Research (SPHR), we will support local decision-making by identifying and evaluating approaches to reducing alcohol-related harm, and evaluate the effects on health and wellbeing of the 'Big Local' initiative in 150 areas in England. In low- and middle-income countries, our research agenda will support the drive for universal coverage of health care, focusing especially on financing, human resources and governance issues.

Cross-sectoral action for health *(Armstrong, Brooker, Cairncross, Chalabi, Clasen, Curtis, Fletcher T, Hajat, Haines, Heise, Kovats, Watts, Wilkinson, Zimmerman)*

- We found that intermittent presumptive treatment of malaria improves the health and cognitive ability of semi-immune schoolchildren in Western Kenya.
- We led research that provided the first rigorous estimates of the global prevalence of exposures to physical and sexual violence by an intimate partner, and completed systematic reviews of the major health impacts of exposures to violence for the Global Burden of Disease study.
- We completed cluster randomised controlled trials of violence prevention interventions in Uganda and Cote D'Ivoire; the Uganda trial is the first in sub-Saharan Africa to show impacts at community level, with reductions in the social acceptance of violence and the prevalence of extra-marital sexual relationships among men.
- We developed a comprehensive new approach to behaviour change (the Evo-Eco model) combining neuroscientific, evolutionary and ecological determinants of behaviour and an

industry approach to advertising, and demonstrated its effectiveness for hand-washing with soap and reducing diarrhoea in infants in rural India.
- We estimated the magnitude of the health co-benefits of policies to mitigate climate change through reduced greenhouse gas emissions from electricity generation, housing, urban transport, and food and agriculture sectors.
- We developed new models for quantifying the impacts of climate change on future global health, showing that it may have significant effects on stunting of children even in the presence of high levels of economic development.
- We plan to: use randomised trials to study the livelihood, dietary and nutritional outcomes of micro-credit to farmers in Bangladesh and land grants to women farmers in Pakistan; explore the intersectoral structural drivers of diseases (e.g. HIV and TB) and interpersonal violence and the health benefits of education, employment, and community development interventions; estimate the health benefits of 'low carbon' diets; and seek to detect and attribute changes in global health to environmental influences including resource depletion and climate change.

Key characteristics of our research environment

Our past and future research aims link closely to national and international policies and initiatives. We seek to achieve an appropriate balance between researcher-initiated discovery from which innovative solutions to global health problems will emerge and research that responds to already identified national and international health priorities. We participate in relevant committees and advisory groups, providing evidence to inform policies and initiatives; guide and respond to research calls to generate new tools and evidence to underpin policies and initiatives; and evaluate the interventions and approaches adopted.

Working in partnership with government to provide evidence for public health action is a very high priority. Our strong links with the DH are indicated by our involvement in 4 of its 10 Policy Research Units (on policy innovation, health-care commissioning, public health, and cancer awareness, screening and early diagnosis), and our membership in the SPHR. With the Department for International Development (DFID), we are involved in four research programme consortia: structural drivers of HIV; unintended pregnancy; health systems; and environmental health.

Our staff are members of 59 UK and European advisory committees and 68 WHO advisory bodies (see impact template). The latter gives us unparalleled opportunities to engage with international policies and initiatives on both disease control and broader issues such as climate change and sustainable development. We also work closely with the Gates Foundation (e.g. on strategies for neonatal health and diagnostics).

As one of the most research intensive institutions in the UK, **we aim to sustain an exceptional creative and supportive research culture** based on an ethos of respect, collaboration and rigorous scientific inquiry. Our unique focus and compact location help create a lively and cohesive culture with numerous opportunities for academic interaction. The significant strengthening of our School Centres in the assessment period has brought major benefits in increased interaction amongst researchers with common interests (including doctoral students). The internal structure of departments and faculties gives students and staff a sense of belonging and identity. Regular meetings and seminars, with a mix of internal and external speakers, provide opportunities to share ongoing research, and stimulate new ideas and collaborations. Annual retreats are organised by Centres, departments and faculties, where activities to support and enhance research life are discussed. Each faculty produces a weekly newsletter, publicising funding

opportunities and new proposals, and announcing new grants, publications and doctoral degree awards.

Conferences, scientific symposia and high-profile lectures add to the richness and diversity of academic exchange. For example, a high point in 2013 was a two-day conference on the legacy of John Snow, which included debate on the application of epidemiological methods in non-health sectors. Since 2012 we have held an annual symposium to enhance interaction amongst UK and overseas staff. The first topic was evaluation, profiling both our world-leading evaluation specialists and the innovative research of postdoctoral and doctoral students.

Since 2008, we have focused on **enhancing the multi- and interdisciplinary nature** of UoA2 research. We have: enhanced our ability to address multidisciplinary questions by investing in high-priority disciplinary areas (see section c); set up new multidisciplinary School Centres (e.g. TB, global NCDs, evaluation, MARCH) to bring together disease specialists with statisticians, economists, modellers, social and political scientists; created new methodological Centres (statistical methodology, mathematical modelling of infectious diseases, genetic epidemiology) to unite quantitative disciplines across the School, strengthening both intra- and interdisciplinary interaction; won new research programmes such as the Leverhulme Centre for Integrative Research in Agriculture and Health (with SOAS and the Royal Veterinary College) whose researchers from anthropology, economics, agriculture, nutrition and public health explore how to achieve sustainable food and agriculture systems that promote health and wellbeing.

Our research strategy includes **mechanisms and practices for developing, promoting and disseminating research**. School support services were reorganised in 2012 and now faculty teams smoothly manage pre-award and post-award grant processes. Our success rates for major funders, for example over 50% for Wellcome Trust applications, reflect the emphasis departments, faculties and Centres place on ensuring strong mechanisms for the development and internal review of research proposals. All applications go through a two-stage review process, assessing relevance and significance, fit with the School Strategy, funder suitability, core science, and ethical issues and risks; fellowship applicants receive a mock interview. Responses to major funding calls are coordinated at School level: e.g. the MRC African research leaders call involved eliciting proposals, initial evaluation, selection of candidates, and finally peer review of full applications.

The restructured central research office provides guidance on funding opportunities and the priorities and application processes of funders. This is reinforced by faculty seminars and workshops on funders. School staff who are journal editors guide sessions on publishing in specific journals. With the creation of an External Relations Department in 2011, greater support has been provided for media and public interactions and non-academic communication. Our public and patient engagement activities encompass both our UK and overseas research, and include participation in research question formulation as well as communication of research findings. We seek funding specifically focused on dissemination, and have been successful in obtaining ESRC follow-on grants (e.g. three for Watts' research on violence against women), and charitable funding (e.g. to Roberts for tranexamic acid promotion).

c. People, including:
i. Staffing strategy and staff development

Staffing strategy
Our research aims strongly guide recruitment and staff development plans. Teaching needs are also closely borne in mind and all academic staff contribute to the teaching programme. Our

central services are structured and supported to deliver professional support to faculties; for example the Division of Education provides comprehensive administrative support for teaching, freeing up academic staff time for research, and we are strengthening induction training for project administrators. External recruitment of senior staff and internal promotion are key elements of the implementation of our research strategy. Recruitments since 2008 have been designed to strengthen priority areas, bring world-leading groups to the School, provide leadership where needed for existing groups and international consortia, build and sustain key UK and overseas partnerships, and recruit the research leaders of the future.

From 2008–2013, our HEFCE-funded appointments in priority areas and disciplines were:

- Professors: Cummins (public health evaluation), Edmunds (infectious disease modelling), Heymann (infectious diseases epidemiology), Lamptey (global NCDs), Lawn (maternal, reproductive and child epidemiology and Director of MARCH), Pearce (epidemiology and biostatistics), Peeling (diagnostics), Scott (vaccine epidemiology).
- Readers: Dudbridge (statistical genetics and epidemiology), Sear (demography).
- Senior Lecturers: Hargreaves (public health evaluation), Parkhurst (global health policy), Reniers (demography), Roberts (health systems and policy).

We place equal importance on supporting and promoting existing staff to become research leaders. Since 2008, of staff submitted in UoA2, 19 have been promoted from Reader to Professor, 15 from Senior Lecturer to Reader, and 42 from Lecturer to Senior Lecturer. This reflects our recent growth in researcher numbers, with a cohort of young researchers developing into our future research leaders. Promotion to Reader and Professor requires a world-class reputation and strong grants and publication record (as well as strong teaching and broader academic contributions). Annual performance reviews of Readers and Professors by Deans of Faculty, reporting to a subcommittee of Council, support senior staff to maintain their productivity and sustain the research groups which employ junior staff.

Implementation of the Concordat

We operate a single academic staff policy: policies and entitlements do not differentiate between HEFCE- and grant-funded staff. Up to Reader level, there is a single salary scale for non-clinical academics; clinical academic salaries are determined in accordance with NHS recommendations. We have a formal policy of bridging researchers between contracts: staff with five years or more continuous service are entitled to six months' underwriting from faculty funds. In 2010 we created a redeployment register for staff at risk of redundancy. Those who register get priority consideration for up-coming positions, and can be appointed following a selection panel without external recruitment. All staff at Lecturer level and above are eligible for study leave, given five years' continuous service and a contract extending at least one year beyond the start of the leave period.

A 'career map' for all academic staff, revised in 2011, provides guidance on the balance between research, teaching and other activities at different career stages. The staff appraisal system supports staff to assess their progress annually with their line manager and provides regular advice on career progression and development needs and opportunities.

Staff are encouraged to use the staff development programme which covers all skills required for successful career progression including designing, writing up and communicating research, research methods, and management and leadership appropriate to early-career, mid-career and senior academics. The probationary requirements of all lecturers include completing at least level 1

of our Postgraduate Certificate in Learning and Teaching. In 2012/2013, 215 UoA2-associated staff attended at least one staff development course.

Early-career researchers are fundamental to our current and future research success, and make up 93 of the 295 researchers submitted in this UoA. We thus have an excellent balance of junior and senior researchers. Early-career researchers represent our future research leaders, drive forward our research programmes, and enliven our research environment. We are successfully nurturing their career development through a range of activities which support and mentor early-career researchers, including reviewing their grant proposals, supporting and facilitating external research and policy links, advising on journal selection strategies, journal clubs, work-in-progress seminars, and practice sessions for conference presentations. Supporting early-career staff to submit fellowship applications is given top priority; in the assessment period 25 postdoctoral fellowships were received by UoA2 submitted staff, and 17 fellowships awarded to our early-career researchers (see section e).

Mid-career development is another critical stage; we support fellowship applications for those with exceptional promise amongst both our own staff and those employed elsewhere. These receive rigorous internal peer-review before submission. In the assessment period 11 were received by UoA2 submitted staff (section e). In the past two years we have used co-funding from the Wellcome Trust Institutional Strategic Support Initiative to award fellowships to outstanding researchers coming to the end of their postdoctoral appointment, allowing them to build a base for future successful applications for external fellowships.

Our health services researchers collaborate closely with the NHS including with clinical staff at UCH and through our research partnerships with three Royal Colleges (Surgeons, Obstetricians and Gynaecologists, and GPs). We also support the career development of clinical researchers through NIHR awards: since 2008, we have received eight public health Academic Clinical Fellowships (ACFs) and three clinical epidemiology/urology ACFs, plus (across both UoAs) five infectious diseases ACFs and four infectious disease academic Clinical Lecturers. In 2013 we joined the board of UCL Partners and are part of its recently awarded Collaboration for Leadership in Applied Health Research and Care (CLAHRC).

Support to staff based overseas

We provide flexible working arrangements for staff, including facilitating prolonged periods working with our partners overseas. Currently, 29 staff submitted to UoA2 are based overseas. Our HR policies provide full support for such staff, including relocation allowances, medical insurance, and support for safety and security. Since 2008, we have appointed a special advisor on overseas programmes, an IT advisor to support overseas projects and staff, and a distance learning specialist to convert staff development materials for remote use. London-based staff interact with overseas staff through regular phone/Skype calls, email and face-to-face visits. Overseas staff receive support to attend our annual School symposium, and we also organise staff development activities and research meetings in the same week.

During the assessment period our overseas clinical researchers (across both UoAs) were supported through the Wellcome Trust Bloomsbury Centre for Clinical Tropical Medicine, which was renewed for five years in 2013 as the Wellcome Trust Bloomsbury Centre for Global Health Research. Through this and the Wellcome Trust-funded clinical PhD programme in international health, we have an excellent track record in recruiting and training outstanding clinical scientists. The Centre, based at the School, is a partnership with UCL, Queen Mary, King's and St George's. Candidates for Wellcome Trust clinical fellowships at the Centre are expected to present their

proposals to the multidisciplinary review panel at least two months before the submission deadline, and are given detailed feedback. As a result, the success rate has been more than 60% over the past five years. The Centre currently supports 27 Wellcome Trust funded clinical fellows (across the five partners) based in 17 institutions in 13 low- and middle-income countries.

Equality and diversity

The School has a strong commitment to equality and diversity and a dedicated Equality and Diversity Manager. Our Equality & Diversity Strategy encompasses characteristics protected by the Equality Act 2010. We have policies on gender, race and disability; a range of 'family-friendly' policies including maternity/paternity/ adoption leave, parental and carer leave, and flexible working arrangements; and underwriting for staff contracts. Equality and diversity is an integral element of policies relating to recruitment, promotions and reviews, support and training, and mentoring and appraisal. All new staff are required to undertake equality training online and attend an appropriate training session. The School is a certified user of the Two Ticks scheme and encourages staff to declare disabilities.

The Equality & Diversity Committee monitors staff data in relation to gender, ethnicity and disability, sexual orientation and religion or belief. In addition the Committee undertakes or contributes to focused reviews in order to investigate potential areas of disparity (e.g. equal pay audit, rate of promotions, career map). The last equal pay audit showed no significant disparity between men and women at the same grade. The School has a Bronze Athena SWAN (Scientific Women's Academic Network) award and two of our three faculties have also recently attained a Bronze award. As a result of Athena SWAN, a cross-faculty support group has been set up for women returning after maternity leave and working part-time. In addition, an Athena Swan Panel has been formed to propose new ways of reducing barriers to career development for women and to comment on the work of the main committees.

53% of the staff submitted to UoA2 are women, and in total these 156 women have had 57 periods of maternity leave. 59 (63%) of our early-career researchers are women, amongst whom there have been 18 periods of maternity leave. Our research successes suggest that our policies are effective in supporting our staff to balance their professional and family roles. In 2013 LSHTM was ranked second in the UK for the percentage of female professors in a report by the University and College Union, but we continue to seek to improve this, for example through participating in the new Aurora initiative. We have identified recruitment to senior posts from outside the School as a particular concern, and are actively seeking to ensure women are represented on shortlists. At a more junior level, women are in the majority and are encouraged to make full use of our family-friendly policies to combine work and family responsibilities.

ii. Research students

As an exclusively postgraduate, research-led institution with a vibrant research-active community, we provide a fertile environment for doctoral study. Around 90% of doctoral students follow the PhD programme, and 10% the DrPH (a research-based professional doctorate). In academic year 2012/2013, 290 doctoral students were studying in UoA2 research areas, and since January 2008 256 students have completed their doctorate. The 2012 Quality Assurance Agency Institutional Review concluded that 'The School offers excellent opportunities for its research students'. In the 2012 Postgraduate Research Experience Survey, 86% of our respondents said they would recommend the School to a friend.

The School has exacting recruitment and selection procedures to register the most promising doctoral students, and an applications-to-offer ratio of 4.4:1. In keeping with our mission, 50% of current doctoral students are from outside the EU. This student diversity is essential to achieving our research objectives but means that Research Council-funded students are in the minority. All students receive the same top-quality training and access to facilities regardless of their funding source. School graduates form a core of skilled researchers in many countries across the world and hold prestigious international appointments, testament to the quality of our training programmes. For example, six recent graduates work with the main policy research institute of the Thai Health Ministry.

In the REF period we secured substantial funding for doctoral training, much of it multidisciplinary. We are part of the ESRC Bloomsbury Doctoral Training Centre for the Social Sciences, and hold an MRC doctoral training grant in vaccine research. From 2008–2013 we awarded the following doctoral fellowships funded from UK sources and with UoA2 supervisors:

- 7 personal fellowships from the Wellcome Trust (3), NIHR (2), ESRC (1), MRC (1)
- 10 from the Wellcome Trust Clinical PhD Programme in International Health
- 3 from the MRC doctoral training grant in vaccine research
- 22 from the ESRC Bloomsbury Doctoral Training Centre for the Social Sciences
- a CASE studentship with a major multinational to work on vector control tools.

Other students come from MRC Units and Public Health England, and the Bloomsbury Colleges PhD Studentships Consortium, which encourages interdisciplinary and collaborative projects between the Bloomsbury colleges, funds eight places. We also offer a small number of doctoral scholarships from endowed funds.

Our international students receive funding from competitive sources such as the Commonwealth Scholarships Commission or their home governments; others are sponsored by their employing institutions or by charitable organisations. In addition, we fund and support doctoral training in London for our overseas partners. For example, our Capacity Strengthening Research Degree scheme covers 18 overseas partners, of which 16 are in Africa, allowing local researchers working with us to register for a subsidised PhD; nine have completed across the School since 2008. Recent Wellcome Trust funding to the UK consortium supporting the Public Health Foundation of India has supported the doctorates of nine students since 2009.

We also support the development of research degree training and postdoctoral programmes of our African partners. For example, across both UoAs:

- we are part of the Malaria Capacity Development Consortium, funded by the Wellcome Trust and the Gates Foundation, which supports the local research training of 18 African PhD students and 30 postdocs working in 10 countries as well as overall postgraduate training programmes at five African universities
- we are a partner in six research capacity-building programmes supported by the Wellcome Trust which fund the local research training of 116 African PhD students and postdocs.

Regardless of whether our doctoral students arrive with their own topic, or develop a topic within an existing research programme, students are fully integrated into research groups, sharing facilities with staff. Centres and departments include students in meetings and journal clubs, while events like the annual Research Degree Student Poster Day encourage sharing of academic work.

Students have access to a very wide range of seminars including PhD upgrading and DrPH review seminars. Students are mentored to develop writing skills, and both supported to lead on their own papers and encouraged to participate in collaborative writing with academic colleagues. Every student has an advisory committee in addition to their main supervisor, including at least two other academics with expertise relevant to the student's research (who may be from another department, or even external to the School).

Students' individual development needs are identified and agreed jointly with supervisors soon after registration and regularly reviewed and updated thereafter. Students can take modules from across the School's extensive portfolio of both face-to-face and distance learning masters-level modules. DrPH students are required to take a taught component comprising two doctoral-level modules in their first year. We also provide numerous opportunities to develop generic, transferable and employment-related skills including an in-house transferable skills programme, further local opportunities via the Bloomsbury Postgraduate Skills Network, online research skills packages, training in teaching methods for students involved in teaching, computing skills, and experience in organisational roles such as running seminar programmes.

New and first-time supervisors are required to attend a workshop on supervision before taking on their first student, and are assigned a mentor. They are also expected to gain experience as a member of an advisory committee before becoming a main supervisor. All supervisors attend a refresher training workshop at least once every five years.

In the future, we plan to further enhance access to doctoral study, building on our current pilot of a +4 pathway (a postgraduate diploma in research methods plus PhD, for those not needing another MSc but without sufficient background for direct PhD entry). We will also continue to develop our broader professional training, preparing doctoral students for future leadership roles.

d. Income, infrastructure and facilities

Income

The School's research activity has risen year on year since 2008/9, with total research income increasing from £60.9m to £79.3m. Research income is obtained primarily from highly competitive, peer-reviewed national and international sources. Total UoA2 research income over the REF period was £199m, an average of £775K per submitted staff member. In addition, we received £89m from funding bodies for payments to our partners based overseas, which is 31% of our total UoA2 research income. Excluding payments to collaborators, 34% of our income over the REF period came from sources outside the EU (of which 31% was from the Gates Foundation), 22% from the UK government, 22% from UK charities and 11% from UK research councils. Research income rose from £35.5m in 2008/2009 to £44.9m in 2012/2013. The most marked change over the period has been the increase in funding from overseas sources, from 29% in 2008/2009 to 34% in 2012/2013.

Annual income figures do not reveal the size of individual grants. In the REF period, UoA2 staff were awarded 73 grants worth over £1m, and 11 grants worth £5m or more, including major programme grants from DFID (£22m), and the Wellcome Trust (£14m). The largest awards were for overseas-based research, including major awards from Gates (£33m) and NIH (£7.6m), of which £16.5m was from Gates and NIH for the PopART study (to measure the population impact of universal test and treat for HIV). Other awards include funding to support overseas partnerships such as a Strategic Award from the Wellcome Trust for the Malawi Epidemiology and Interventions

Research Unit (£5.6m). A total of £13.4m was received from the DH for the three policy research units which we lead, and £7.5m in successive MRC grants for the Tropical Epidemiology Group.

Infrastructure and facilities

During the assessment period we made major capital investments in research facilities, disposed of satellite buildings and consolidated our research and teaching in two main buildings. The 2,400m^2, £14m South Courtyard development, completed in April 2009, includes dedicated research office space, lecture theatres, open plan space for meetings and receptions, and a large suite of teaching and meeting rooms. We also purchased and refurbished a nearby building on Tavistock Place (£28m, 2,942m^2), providing open plan and traditional offices and a variety of meeting spaces. We are now able to provide more coherent, flexible space for research groups and better integration and facilities for our large cohort of doctoral students, all of whom have an allocated desk or hot desk with personal storage.

Major laboratory developments have benefited staff submitted in UoA1, and thus indirectly benefited UoA2 staff through facilitating world-class science. In particular, a refurbished animal facility provides state-of-the-art infrastructure including Category 3 (BCL3) live imaging.

An essential part of our research infrastructure is a responsive, modern, well-resourced and reliable IT environment. Our significant investments over the past five years have resulted in data centres with expanded network storage in both Keppel Street and Tavistock Place to provide resilience; the virtualisation of much of the IT infrastructure, allowing more economic use of servers and greater resilience; an 8gb fibre network, enabling fast access to digital resources; and the further development of high-performance computing technology for specialised modelling. In 2012 we recruited a Head of IT Security and Compliance to further strengthen our central IT Services Department. IT partners within this department work closely with the faculties to which they are affiliated, enhancing communication between faculties and IT Services and improving delivery against agreed service-level agreements.

We increasingly make use of large routine data sets and have set up the necessary secure facilities. We use the UK Clinical Practice Research Datalink (CPRD) and a number of other data sources such as Hospital Episode Statistics, the Myocardial Ischaemia National Audit Project, the Cancer Registry and Medicare data from the USA. At the start of a study, researchers store original datasets on the School's secure server, which is accessible only to members of the group. During the study, all anonymised statistical analysis files and datasets are stored on the researcher's computer or external hard drive and backed-up. Once a study is completed, data are archived on the School's secure server. Physical media (such as key fobs or datasets) and any physical copies of the data are held in a safe. For the CPRD, a research assistant dedicates one day a week to providing data-management support.

During the assessment period we established a Clinical Trials Unit to support our multi-centre trials. The Unit was awarded full UKCRC registration in December 2009, renewed in August 2012 with comments that 'the unit had presented a well constructed and considered application which provides clear evidence of established operational experience in the design and delivery of large-scale multi-centre trials supported by a strong set of publications'. The unit was expanded in 2013 with an additional two positions allocated for IT support and administration. We also maintain three Cochrane Review groups at the School, on eyes, injuries and heart.

As outlined in our UoA1 submission, we and UCL have jointly established the Bloomsbury Research Institute (BRI) for work on pathogens and associated diseases, and a feasibility study

has been completed for a new shared laboratory building at our Tavistock Place site. This multidisciplinary initiative will have major benefits for the research of UoA2.

Our School Library has extensive collections of print and electronic material in the fields of public and global health. The historical collections include archival material from scientific, medical and global health professionals together with rare book collections in relevant areas. Electronic resources can be accessed from anywhere in the world via an internet connection. All current journal subscriptions are available electronically, together with a growing number of ebooks. The Library also provides support for a wide range of bibliographic databases in the areas of the School's research. A programme of teaching sessions on effective literature searching runs throughout the year and specialist Library staff also give individual advice. The Library & Archives Service is responsible for the School's repository (LSHTM Research Online), and dedicated staff provide support and advice on open access publishing, research data management, freedom of information and data protection. A data management policy has been developed, requiring all projects to have a data management plan, and we are on track to comply with EPSRC expectations on research data management by May 2015.

Our overseas researchers benefit greatly from our partners' facilities. For example, in Tanzania our researchers working with the Ifakara Research Institute in Dar-es-Salaam are accommodated in its buildings; our Mwanza Intervention Trials Unit is supported by the Tanzanian National Institute for Medical Research which provided land for a new building; and the Kilimanjaro Christian Medical College in Moshi provides laboratory, office space and insectaries for our Joint Malaria Programme; the Ministry of Health in Malawi houses our research programme; and the Public Health Foundation of India hosts the Wellcome Trust funded South Asian Network on Chronic Disease (SANCD).

Research governance

Our Quality and Governance Manager (QGM) is responsible for ensuring that all research is undertaken to the highest standards in accordance with UK law and the School's *Guidelines on Good Research Practice*. The *Guidelines* follow national guidance from Research Councils UK and the UK Research Integrity Office and are supported by detailed policies for ethical review, health and safety, grant management, research management, confidentiality of data and records, intellectual property, working with the private sector, and investigating allegations of misconduct. These policies are currently being reviewed to ensure conformity with the Concordat for Research Integrity.

During the assessment period the School revised its ethical review process, splitting the former ethics committee into one for observational studies and another for interventions. All research projects with human participants involving a School staff member or doctoral student must be reviewed by one of these committees, and most receive a first or final decision within four weeks. All overseas projects must also receive approval from the relevant overseas partner country ethics committee and, for clinical trials, from their FDA equivalent.

A clinical trials sub-committee was established in 2008 to ensure we meet our responsibilities and obligations as a sponsor of clinical trials. Procedures and templates are available to help researchers develop high-quality protocols that comply with the current regulatory framework. Clinical trials and projects involving human tissue (including tissue storage facilities) are regularly audited by the QGM to ensure compliance with study protocols, the Human Tissue Act and other applicable regulations, good clinical practice, good clinical laboratory practice and our *Guidelines*.

A 2013 inspection by the Medicines and Healthcare Products Regulatory Agency (MHRA) found examples of good practice and no critical issues.

e. Collaboration and contribution to the discipline or research base

This section focuses on our research environment from a broader perspective. The frequent citing of our research, our numerous awards, fellowships and positions on public and global health research bodies, and our extensive involvement in peer-review processes (e.g. grants committees, journal editorships) are all strong indicators that our research and staff have a wide influence and that both are held in high regard. Our strategic academic partnerships, our work within low- and middle-income countries, and our engagement with industry, NGOs and multilateral agencies show our deep commitment both to collaboration and to responding to changing national and international priorities, and indeed to shaping those priorities.

To take an example, increasing world food prices have focused attention on nutrition, a highly neglected topic in international development and one where we have major expertise. DFID, unprepared for the price increase, had no advisors with expertise in nutrition. We helped DFID develop a nutrition White Paper, and one of our senior nutritionists now works part time for DFID as Senior Research Fellow to advise on the nutrition research agenda and country programmes. To expand our nutrition and agriculture research, we applied successfully to Leverhulme, and were recently selected to lead a DFID-funded research consortium to identify agricultural interventions that improve nutrition in South Asia. Most recently, LIDC was selected to host the secretariat of the Global Panel on Agriculture and Food Systems for Nutrition, chaired by John Beddington, former UK Chief Scientific Advisor, and John Kufuor, former President of Ghana.

There are numerous examples where our research and related advocacy has stimulated funding for further research. For example, through Patel's global advocacy for mental health, especially the *Lancet* series he led and its call to action, we have raised awareness of the need for research on mental health in poor countries. In 2010/2011 alone, over £25m was made available including by DFID (£6m), and the US National Institute of Mental Health ($12.5m).

Indicators of wider influence

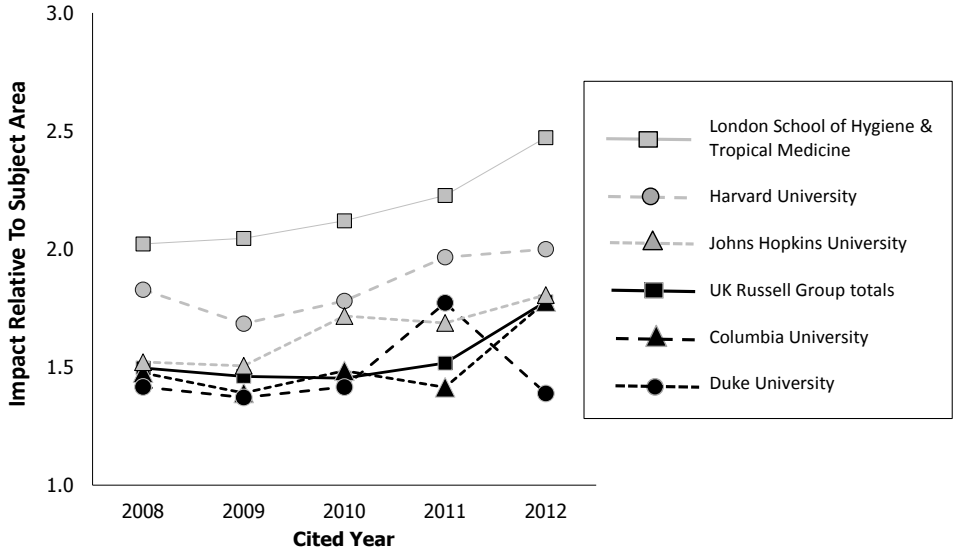
Our research is amongst the most highly cited in its field. The figure on the following page shows that we are ranked well above the Russell Group average in the subject area of UoA2, and well above our main US competitors.

Awards received and external positions held during the REF assessment period include: Hideyo Noguchi Africa Prize, given to honour outstanding achievements in medical research to combat infectious and other diseases in Africa (Greenwood 2008, Piot 2013); Gairdner Global Health Award (Greenwood 2012); Fellow of Royal Society (Mills 2013); Prince Mahidol Award for Medicine (Mills 2009); Fellow of the Academy of Medical Sciences (Hayes, Mills, Patel, Pearce, Piot, Prentice, Scott, Whitty 2008–2013);DBE (Bertschinger 2010); Knighthood (Hall 2013, Greenwood 2012); CMG (Piot 2010); CBE (Heymann 2009, Cleland 2008); OBE (Cairncross 2011); President of international societies (International Epidemiological Association, Pearce, 2008–2010); International Health Economics Association (Mills 2012–2013); International Union of Nutrition Sciences (Uauy 2010–2012); European Association of Public Health, President elect (McKee 2014–2016); global career achievement prize from the International Society for Quality in Healthcare, in recognition of work on patient reported outcome measures (Black 2013); lifetime achievement award from the African Ministerial Conference on Water for contribution to research to improve access to water and sanitation (Cairncross 2011); *Health Service Journal*'s Clinical

Leaders list (Black, Goldacre 2013); Kenneth Rothman Epidemiology Prize for the best paper published in epidemiology (Milojevic, early career researcher 2012); Max Perutz Science Writing Award (Bastawrous 2012).

Impact relative to subject area for selected institutions

Data taken from Thomson Reuters InCites™ Global Comparisons dataset



InCites™, Thomson Reuters (2012), *Comparison of subject areas in institutions 2008-2012 report*. Report created 4 September 2013, data processed 31.1.2013

UoA2 staff were members of 70 grants committees in the assessment period, including: Royal Society (Greenwood); MRC (e.g. Strategy Board and Global Health Group, Haines then Piot; Infection and Immunity, Hayes; Population and Systems Medicine, Leon, deputy chair, Pearce; Molecular and Cellular Medicine, Rodrigues; Methodology, Green; Strategic Skills Fellowship, Cummins and Kenward); ESRC (Grant Advisory Panel C, Smith R, chair); NIHR panels and boards (e.g. Biomedical Research Fellowships Panel, De Stavola; Public Health Research Board, Petticrew; Health Services and Delivery Research Board, Mays); Wellcome Trust (Population and Public Health, Edmunds, Kirkwood; Strategic Awards, Smith P); EU (EDCTP scientific strategy board, Jaffar, chair); Gates Foundation (Global Mental Health Grand Challenges Review Panel, Patel, co-chair; diagnostics grants, Peeling); WHO Polio Research Committee (Edmunds).

School journals include two which lead in their field: *Journal of Health Services Research and Policy* (Editors Black, Mays), and *Health Policy and Planning* (Co-editor Coker, section editors Borghi, Goodman, Mounier-Jack, Schellenberg J). In total, 21 submitted staff in UoA2 held Editor, Editor-in-chief and Section Editor roles from 2008–2013 including Co-editors of the *International Journal of Epidemiology* (Ebrahim, Leon), *Tropical Medicine* and *International Health* (Cairncross, Jaffar). A total of 129 UoA2 staff were editorial board members of journals (e.g. *International Journal of Epidemiology*, *The Lancet*, *Biostatistics*, *Advances in Parasitology*, *Clinical Ethics*, *Social Science and Medicine*, *BMJ*).

Over the REF period UoA2 submitted staff received the following 41 personal fellowships: British Academy Postdoctoral Fellowship (Stoeckl 2011); Cancer Research UK Population Research Postdoctoral Fellowship (Woods 2008); EC Marie Curie Intra-European Fellowship for Career Development (Nuesch 2011); ESRC/MRC/NIHR Early Career Fellowship in Health Economics

(Lagarde 2010); ESRC/MRC Interdisciplinary Postdoctoral Fellowship (Stoeckl 2009, Boccia 2010); MRC Early Career Fellowship in Economics of Health (Gomes 2013); MRC Population Health Scientist Fellowship (Ploubidis 2009, Doyle 2010, Quint 2010, Wringe 2010, Francis 2011, Cairns 2012, Lawson 2013); MRC Career Development Award in Biostatistics (Daniel 2011, Bartlett 2013, Funk 2013, Kucharski 2013); MRC Methodology Research Fellowship (White 2009, Douglas 2009, Gasparrini 2011); NIHR Postdoctoral Research Fellowship (Lock 2008, Goodman 2010, Bhaskaran 2011, Harris 2011, Rogers 2013); NIHR Clinician Scientist Fellowship (Langan 2010); NIHR Career Development Fellowship (Thomas 2010, Eames 2011); NIHR Senior Research Fellowship (Cummins 2010); Wellcome Trust Henry Wellcome Fellowship (Metras 2013); Wellcome Trust Medical History and Humanities Research Fellowship (Walters 2011); Wellcome Trust Intermediate Clinical Fellow (Solomon 2012, Tomlinson 2013); Wellcome Trust Career Development Fellowship (McCambridge 2008, McGrath 2008); Wellcome Trust Senior Research Fellowship in Basic Biomedical Science (Brooker 2012); Wellcome Trust Senior Research Fellowship in Clinical Science (Corbett 2010, Patel renewed 2010, Smeeth renewed 2012); Wellcome Trust New Investigator Award in Medical History (Mold 2013).

Effective academic collaboration

Our success in establishing and sustaining research partnerships is evidenced by the number of multi-centre studies involving School staff, and the resulting high-profile publications; 92.5% of papers are published in collaboration with researchers from other institutions, putting us first in the UK for this indicator in the Leiden Ranking for biomedical and health sciences (and seventh in the world). We also top the UK rankings (second in the world) for the proportion of papers published with researchers from outside the UK – 71.8%. Another indicator of our extensive collaborations is our participation in *Lancet* special series, which address priority global health issues such as mental health and maternal survival. Since 2008 we have participated in 27 different series, co-leading seven and contributing 81 papers.

The UK and Europe

Key UK partners include UCL, Sanger Institute, Public Health England and the Bloomsbury Colleges. With UCL, research collaboration occurs across the breadth of research within this submission, including epidemiological studies, clinical trials, public health and health services. We have established the joint BRI and become a board member of UCL Partners; we were part of a successful 2012 bid to MRC for an E-Health Informatics Research Centre (now part of the Farr Institute) and a 2013 bid for an NIHR Collaboration for Leadership in Applied Health Research and Care (CLAHRC). Our links with the Sanger Institute are critical for our genetic epidemiology research. Our wide-ranging collaborations with Public Health England encompass vaccine studies, mathematical modelling, sexual health, drugs and environmental change. In the recent call for NIHR-funded Health Protection Research Units, all five of the School's bids were successful in getting to the second stage. In addition, many staff from Public Health England have part-time or honorary contracts with LSHTM including the PHE chair.

Our academic partnership in LIDC has been an outstanding success (other members are Birkbeck College, Institute of Education, SOAS, the Royal Veterinary College, and the School of Pharmacy until 2012 when it joined UCL). LIDC has enabled the School to benefit greatly from the strengths in overseas development in other colleges, leading to many successful initiatives, notably the £3.5m Leverhulme grant to integrate agricultural and health research.

Nationwide, our academic collaborations are such that from 2008–2013, School staff published with 94 UK HEIs. Two leading collaborative examples are: we are one of the seven members of the NIHR National School of Public Health Research, especially contributing methodological

expertise; we are part of the London Centre for Neglected Tropical Disease Research, with Imperial College and the Natural History Museum.

We have extensive academic collaborations with many European and Central Asian countries. One of the School Centres, the European Centre on Health of Societies in Transition (ECOHOST) is the largest research grouping in the world specialising in research on health care, health policy and public health in central and eastern European countries and in the former Soviet Union; it is also a partner in the European Observatory on Health Systems and Policies with special responsibility for work in the former Soviet Union.

Low- and middle-income countries

Partnerships in low- and middle-income countries are also essential for our research aims; our main African research partnerships are shown below. Funders for these partnerships are primarily the Wellcome Trust, MRC, the Gates Foundation, DFID and the EC.

Country and institution(s)	Country-based staff	Other senior UoA2 staff	Main research areas
Benin: Regional Center for Entomological Researches of Cotonou	N'Guessan	Fielding, Glynn, Greenwood, Hanson, Kleinschmidt, Schellenberg D, Rowland	Malaria, TB, health economics
The Gambia: MRC Unit	Scott, Zaman	Chandramohan, Greenwood	Vaccine-preventable diseases, malaria
Ghana: Kintampo Health Research Centre; Kwame Nkrumah University of Science & Technology	Newton, Owusu-Agyei, Shannon, Tagbor	Chandramohan, Greenwood, Hanson, Milligan, Rowland, Schellenberg D, Webster, Whitty	Malaria, HIV, TB, health economics, NCDs, maternal and newborn health, health services/ systems
Kenya: Kenya Medical Research Institute – Wellcome Trust Centre; International Centre of Insect Physiology and Ecology	Fillinger	Brooker, Fielding, Gilson, Goodman, Griffiths, Hanson, Hayes, Rhodes, Scott, Todd, Zaba	Vaccine preventable diseases, malaria, TB, HIV, NCDs, neglected tropical diseases, eye diseases, health services/systems
Malawi: Malawi Epidemiology and Intervention Research Unit; Malawi-Liverpool Wellcome Trust Research Programme, College of Medicine	Aberbir, Corbett, Crampin, Koole	Chandramohan, Floyd, Glynn, Jaffar, Rowland, Staedke, Todd, Webster, Whitty, Zaba	TB, HIV, leprosy, NCDs, health systems/services, demography
Senegal: Université Cheikh Anta Diop (University of Dakar)	Cisse	Chandramohan, Greenwood, Milligan, Schellenberg D, Webster, Wiseman	Malaria, health services/ systems
South Africa: Universities of Cape Town, KwaZulu-Natal, Stellenbosch, Western Cape, Witwatersrand; Africa Centre for Health and Population	Gilson	Fielding, Floyd, Godfrey-Faussett, Hanson, Hargreaves, Hayes, Mills, Moore, Patel, Todd, Vassall, Watts, White, Zaba	HIV, TB, STIs, mental health, gender inequality and violence, health systems & services research, health economics

Tanzania: Mwanza Intervention Trials Unit; National Institute for Medical Research; Muhimbili University of Health & Allied Sciences; Ifakara Health Institute; Kilimanjaro Christian Medical College; Sokoine University	Cox, Grosskurth, Kapiga, Patouillard, Todd	Borghi, Chandramohan, Filteau, Gilbert, Goodman, Hayes, Jaffar, Mills, Ross, Schellenberg D, Schellenberg J, Watts, Weiss, Whitty, Zaba	HIV, intervention trials, demography, sickle cell disease, malaria, nutrition, STIs, TB, NCDs, health systems/ services, eye diseases, maternal and newborn health, health economics, gender violence
Uganda: MRC/UVRI Uganda Research Unit; Uganda Malaria Surveillance Project; Makerere University	Staedke	Crampin, Grosskurth, Hayes, Heise, Kapiga, Patel, de Silva, Todd, Watts, Weiss, White, Zaba	HIV, TB, STIs, malaria, violence against children, NCDs, maternal and newborn health
Zambia: University of Zambia	UoA1 staff (eg Ayles)	Floyd, Godfrey-Faussett, Hayes, Fielding	HIV, TB, health services/systems

In Asia, we have many long-standing partnerships, especially with Indian institutions. Collaboration with the Public Health Foundation of India has expanded recently through two large Wellcome Trust funded programmes. One, the South Asian Network for Chronic Disease Research, focuses on cardiovascular risk factors and interventions to reduce cardiovascular disease (Ebrahim) and links seven research groups across three countries. The second, on mental health (Patel), has pioneered the testing of low-cost interventions addressing the main burdens of mental health. In South America, we have especially strong partnerships in Brazil and Peru.

Supporting research capacity-strengthening for public health is part of our mission and a key feature of our partnerships in low- and middle-income countries. We also engage extensively with the research capacity-strengthening agenda of development agencies and research funders. Our staff have an impressive track record in supporting and mentoring local scientists. Since 2008 we have strengthened our partnerships with universities in low-income countries, supporting the development of local masters and doctoral training programmes. For example, as noted earlier, the School supports six Wellcome Trust funded African research capacity-strengthening programmes. It also coordinates the UK partners in the Wellcome Trust's support to the development of the Public Health Foundation of India. More broadly, many of our multi-country research consortia, such as those funded by DFID, have a strong research capacity element delivered through on-the-job training while doing research.

Interacting with industry, NGOs and multilateral agencies

Our work with industry is expanding and is a priority for further development.

- We have recently established a company, Chariot Innovations, as a vehicle for managing industry relationships; the first venture, Arctec, tests insecticides and repellents and its clients include pharmaceutical, pesticide and clothing companies.
- We are working with a private-sector partner to develop a trap for bed bugs which has attracted interest from the hotel industry.
- We work closely with industry on the development and testing of insecticide products for house spraying and mosquito nets in Africa and Asia.
- We have run successful trials on our impregnated bed-net test in Nigeria and Sierra Leone and have interest from NGOs and UN agencies in buying the test kits.

- We are developing an innovative, low-cost portable eye examination kit consisting of a mobile app and clip-on hardware that transforms a smartphone into a tool that can check glasses' prescription, diagnose cataracts and examine the back of the eye for disease. There have been several thousand enquiries including from health ministries, NGOs and telecommunications partners interested in purchasing it for 'bottom of the pyramid' users.
- We are at an early stage of developing several diagnostic tests and 20 pharmaceutical companies have expressed interest in supporting an international centre for diagnostic expertise, which we plan to set up as a social enterprise.

Pocock and colleagues have a particular expertise in acting as the independent statistical centre for clinical trials sponsored by the pharmaceutical and medical device industries, especially for cardiovascular diseases. At any one time, there are around 20 to 30 such major international clinical trials, with our involvement encompassing various roles such as membership of trial data monitoring committees, confidential interim analyses of accumulating data, membership of trial steering or executive committees, responsibility for all analyses relating to publications, and follow-up multi-author publications with academic cardiologists.

We have extensive relationships with the private sector's corporate social responsibility agenda. For example, we are leading the evaluation of the very large Merck for Mothers programme 'committed to saving mothers' lives'. We also partner with major multinationals to promote handwashing with soap. Finally, as laid out in our impact template, we work extensively with multilateral agencies and NGOs to advise on and evaluate their programmes.

Strengthening existing strategic partnerships and forging new ones

In our Strategy 2012–2017, strategic partnerships are a core element and we have made significant effort to further develop and sustain these collaborations. At the highest level, the Director and Vice Director interact regularly with our strategic partners to ensure common understanding and a supportive environment. Memoranda of understanding are agreed to provide the framework for partnerships, and specific agreements made for particular initiatives. As noted on earlier the School has extensive policies which support its staff to live and work overseas.

While strengthening existing partnerships in the UK, Africa, India and South America, the School is also pursuing new ones in Asia. For example, in 2012 we established a strategic partnership with the National University of Singapore's new School of Public Health. Our Director is on the School's Advisory Council, and one of our Professors (Coker) moved there to head its infectious disease and health systems initiative. We see this collaboration as a critical development which in the longer term will position the School strongly within the region, well placed to contribute to health gains in a rapidly growing part of the world as well as to study global health threats that originate in Asia. We are also pursuing strategic partnerships within China, building on earlier and continuing links in STIs and malaria research. New partnerships have been agreed with the Schools of Public Health of the Universities of Peking, Sechuan and Kunming, to build up their research capacity in health systems science. The School's Vice Director is leading these latter developments, which are being supported by 14 masters scholarships to train future Chinese research leaders in this area.

In summary, guided by the aims of our 2012–2017 School Strategy, we will continue to strive for excellence in public and global health research, doctoral training and the translation of knowledge into policy and practice. We will work closely with our partners in the UK and worldwide to address contemporary and future critical health challenges, supported by our world-class researchers, students and infrastructure, and building on our innovative research programmes and multidisciplinary School Centres.