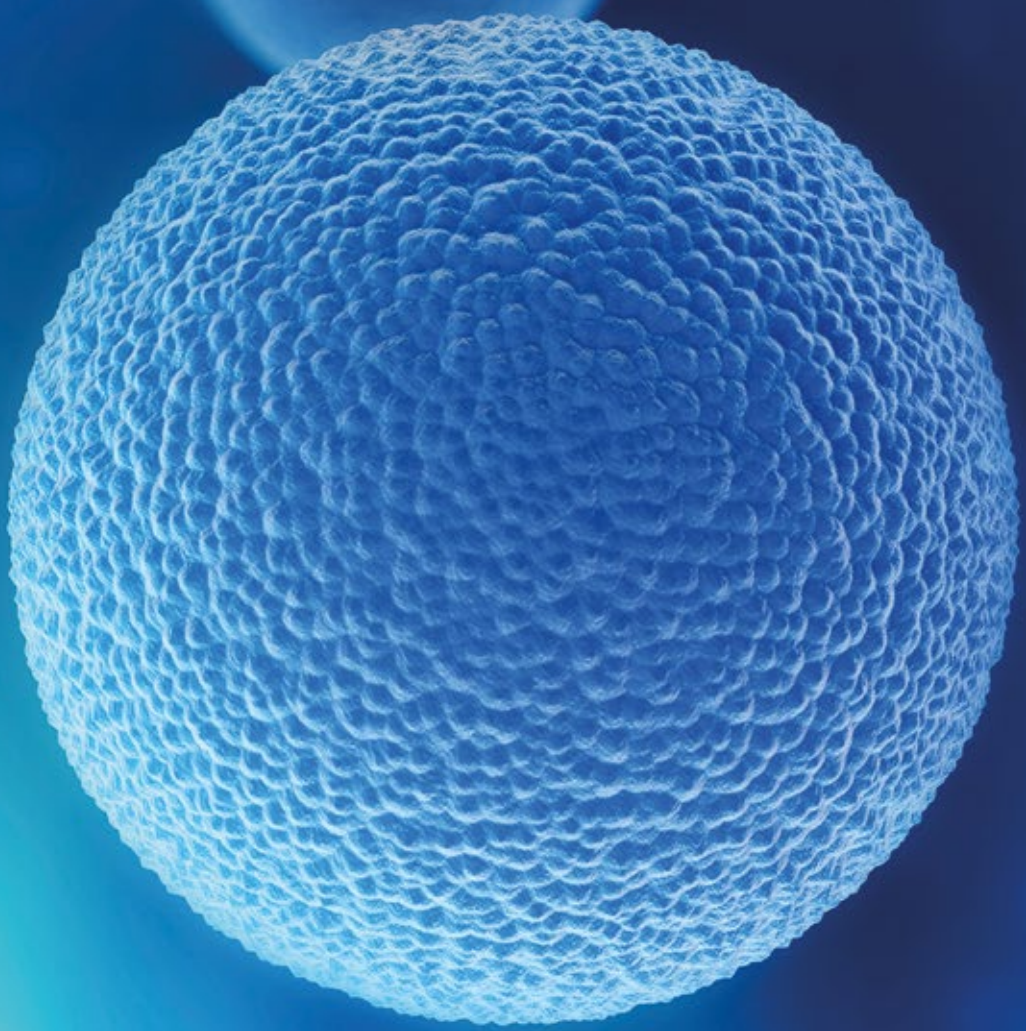
UNIVERSITY OF Southampton

Network for Anti-Microbial Resistance and Infection Prevention (NAMRIP)

2015-2018



NAMRIP Summer Conference 2016

Dr Claire Jackson presenting Cillia exhibit to Dame Sally Davies

Audience at NAMRIP Launch Conf 2015

Baroness Rolfe & Prof Leighton - NAMRIP visit in 2016

Global-NAMRIP Conference delegates, Accra, Ghana, 2018

Panel discussion with Prof Rob Read and Dr Emma Roe

Ben Ward, Sir Snowden, Lord Selborne & Prof Leighton - NAMRIP Conf 2017

Dr Sandra Wilks explains catheter exhibit

Introduction

NAMRIP (the Network for Anti-Microbial Resistance and Infection Prevention) was formed in 2015 to produce ground-breaking advances in tackling Anti-Microbial Resistance (AMR), Infection Prevention and Vaccination.

This brochure records NAMRIP's work up to 2018, the majority of the activities being made possible by a 2.5 year grant from EPSRC (NAMRA 'Bridging the Gap' EP/MO27260/1, dated 1/1/2015-30/12/2017). Funding pump priming, administration and networking, this superb backing allowed us to grow from an initial £10,000 stake as a new University Strategic Research Group (USRG), to bring in over £10 million of funds for specific research projects. Our sponsors are MRC, EPSRC, ESRC, BBSRC, NIHR, NERC, Newton Fund, Royal College of Surgeons, Innovate UK, FSA, Commonwealth Fellowship Commission, Wellcome Trust, the Royal Society and industry.

These funds have produced ground-breaking multidisciplinary research in innovative diagnostic devices, novel methods for vaccination, new chemicals and devices supporting healthcare, animal husbandry, farming, and the provision of safe food. Partnerships between researchers in physical and life sciences, engineering and humanities, clinicians, veterinarians, manufacturers, retailers and policymakers, means that whilst NAMRIP began through tax-payer support, moving forward our return-on-investment relies proportionately less on the taxpayer as NAMRIP's outputs secure other funding (e.g. from manufacturers), making us sustainable longer term.

Our vision is to secure funding for our Global-NAMRIP network, to solve the problems of AMR in Low/Middle Income Countries (LMICs). We took the first step towards this goal by holding the first Global-NAMRIP conference in Ghana in March this year (2018) with a second planned for March 2019 in Uganda.

Thank you to EPSRC and all those who have sponsored us. You have enabled us to meet, run projects and work towards translating our research to help millions of people.

Professor Tim Leighton FRS FREng FMedSci
Chair of NAMRIP

Refer to the NAMRIP website for an up-to-date list of funded projects with sponsors, available at:
www.southampton.ac.uk/namrip/about/index.page

What is Anti-Microbial Resistance

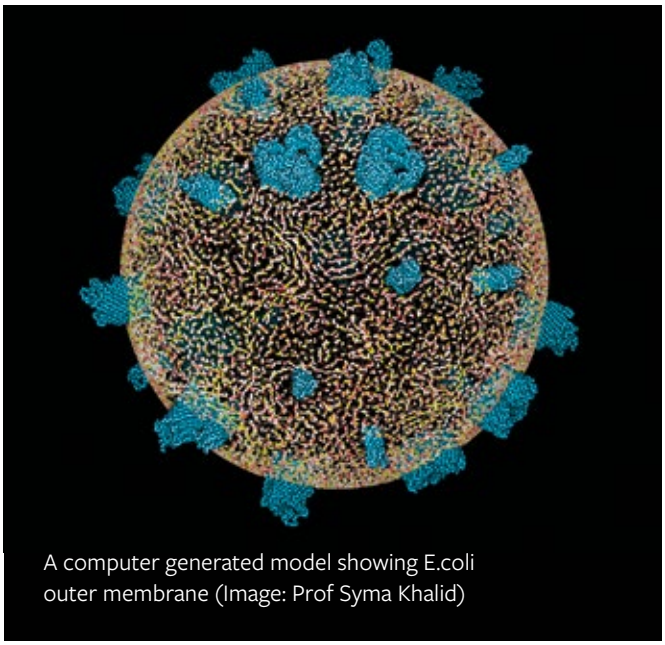
Anti-Microbial Resistance (AMR) is the resistance of microbes to the drugs used to combat them: the ability of bacteria to resist antibiotics, the ability of viruses to resist antiviral agents, the ability of fungi to resist antifungal agents, and the ability of parasites (such as those which cause malaria) to resist the drugs used against them.

AMR is a threat to everyone. Effective and impactful visual communication with the public is vital, to counter the common misconception that 'antibiotic resistance' describes an individual human developing resistance to antibiotics, leading to the common erroneous perception that 'by not taking too many antibiotics now, they will be effective for me when I really need them'. The increased use of antimicrobials in the last few decades means microbes are exposed to a much larger number and greater prevalence of antimicrobials. This increases their chances of developing resistance. At the same time a very limited number of new antimicrobials (antibiotics in particular) are being developed to replace those that are becoming decreasingly effective due to rising drug resistance.

A lack of rapid diagnostics contributes to the problem. Owing to the current time delay in testing for different diseases, patients are treated with broad-spectrum drugs which may or may not cure the patient but still increase the likelihood of the microbes developing resistance.

There is also a dependence on using antimicrobials to treat high rates of infection as opposed to looking at how infections could be prevented in the first place, through vaccination, cleaning, the introduction of minimally invasive procedures etc. 'Stewardship' refers to making better choices about what antimicrobial to use, and when, to reduce the development of resistance.

Finally AMR cannot be solved by one solution or by one country. It requires a multi-disciplinary approach and coordination across the world.



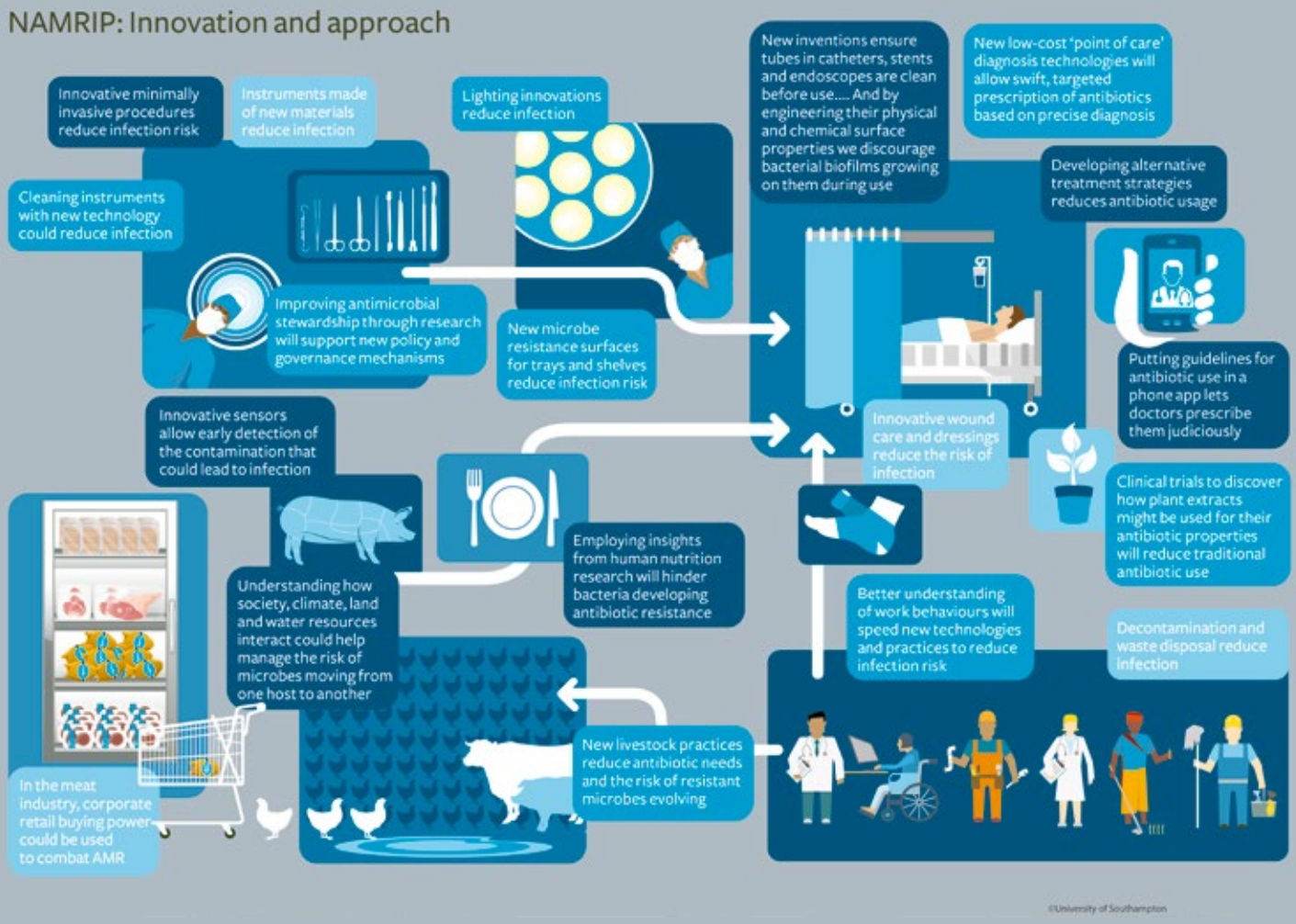
A computer generated model showing E.coli outer membrane (Image: Prof Syma Khalid)

The UK Government commissioned Lord O'Neill (who subsequently presented the keynote talk at our 2017 NAMRIP conference) to analyse the global problem of rising drug resistance and propose actions to tackle it. His final report published in 2016 highlights the size of the problem *'by 2050, 10 million lives a year and a cumulative 100 trillion USD of economic output are at risk due to the rise of drug resistant infections if we do not find proactive solutions now to slow down the rise of drug resistance. Even today, 700,000 people die of resistant infections every year....if* [*antibiotics*] *lose their effectiveness, key medical procedures* (*such as gut surgery, caesarean sections, joint replacements, and treatments that depress the immune system, such as chemotherapy for cancer*) *could become too dangerous to perform. Most of the direct and much of the indirect impact of AMR will fall on low- and middle-income countries.'*

Lord O'Neill presenting the keynote talk at the 2017 NAMRIP Conference

NAMRIP's approach to tackling AMR

By supporting monthly networking events, annual conferences and pump priming projects, the EPSRC 'Bridging the Gap' grant enabled academics from across the disciplines including engineers, physical scientists, clinicians and social scientists to share their knowledge, make new connections and work together in novel ways to tackle AMR. All 39 pump priming projects were awarded to new collaborations, with 23 going on to receive follow-on funding from new sources (see Appendix 1 for projects awarded pump priming). The events and activities enabled NAMRIP to grow to over 200 members including researchers from around the world and external members from industry and the Civil Service. Opportunities arose through this grant that would otherwise not been possible.



The infographic above shows the different areas of our lives affected by AMR and the diverse range of projects NAMRIP members have undertaken. It highlights some of the interconnections between areas and demonstrates why a multi-disciplinary approach to solving this issue is crucial.

Our research is split into five broad themes:
1 – Preventing Infection
2 – Behaviour in the wider world
3 – Pharmacology and Therapeutics
4 – Sensing and diagnostics
5 – Clean water, sewage and waste

More information on NAMRIP's research can be found on the NAMRIP website:
www.southampton.ac.uk/namrip/research/index.page

Pump Priming Projects

39 **Pump priming projects** funded via **8 funding calls**

27 Different **Project Investigators** (PI's)

23 Awards of **follow-on funding**

9 **Prizes/awards** received

51 Conference **presentations**

5 Conference **posters**

11 **Projects** with **Early Career Researchers** as PI's

19 Collaborative links with **industry and government**

7 Collaborative links with **Low/middle income countries**

8 Popular **science papers**

18 **Academic journal papers** published from pump priming (amongst hundreds from members funded through traditional means)

19 **Short videos** produced describing research to lay audience

17 **Exhibits** for Public Engagement

33 **Public engagement** activities

2 major **new research centres** (funded to around £41M)

12 **Patents**

3 TV/radio **interviews**

1 **Spin-out company**

14 **Studentships**

The criteria for all projects was that they must bridge the gap between Engineering and Physical Science (EPS) disciplines and topics outside of those categories (non-EPS), for example a chemist collaborating with a clinician or a social scientist with an engineer, many collaborations featuring more than 2 disciplines.

The original plan was to allocate pump priming funds to around 20 projects. However, by asking applications to find matched funding where feasible, we were able to almost double that with 39 pump priming grants awarded. Each of our 8 funding calls was competitively judged, with successful projects typically allocated around £20k funding for researcher time or consumables. An AMR 'Future Leaders' programme was established for Early Career Researchers (ECRs) resulting in 11 ECR led pump priming projects. In addition to producing a final report, each Project Lead reported back at monthly theme meetings and at NAMRIP conferences, generating further interest and collaborations. Example projects are detailed below (the full list of projects can be found in Appendix 1).

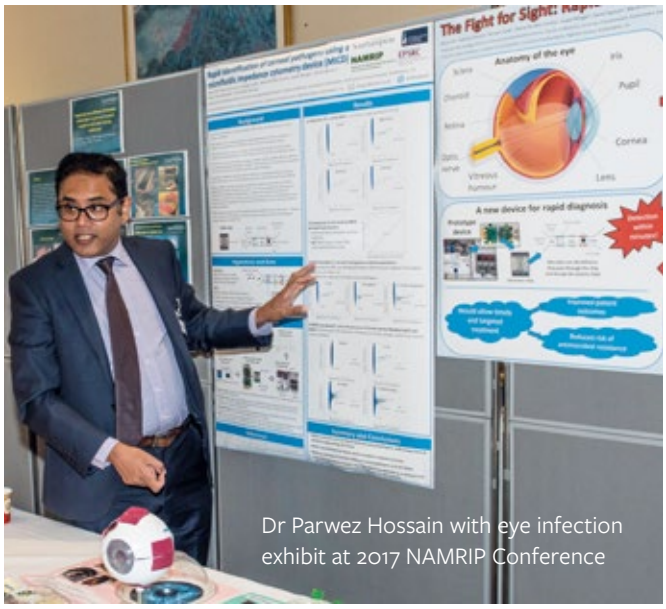
Examples of NAMRIP Pump Priming Projects

Identifying eye infections

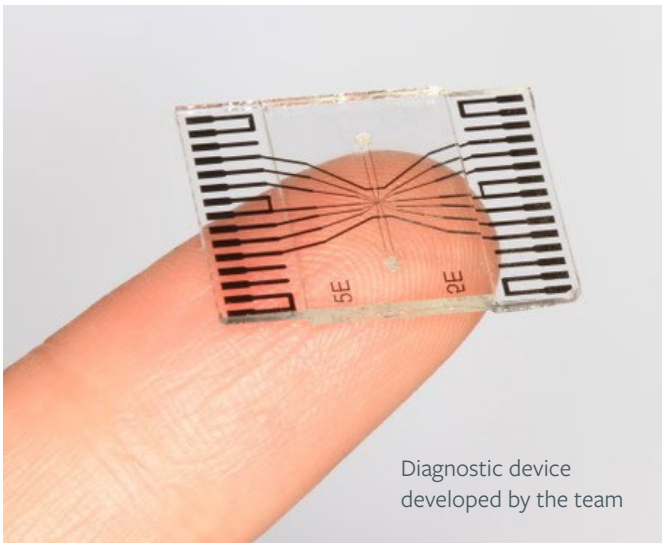
Led by Professor Parwez Hossain, this team from Electronic Engineering, Molecular Microbiology and the Ophthalmology (Eye Unit) at University Hospital Southampton was a new collaboration established at a NAMRIP networking event.

Using technology known as electrical impedance measurement, they developed a portable device to rapidly identify different types of bacteria in infected eye tissue, using just a drop of specimen tear fluid from the eye.

Worldwide there are around 2 million cases of corneal infection per year contributing to unilateral blindness. In the UK alone there are 6000 cases of corneal infection per year with delays in diagnosis and pathogen identification a major contributing cause for poor prognosis. Poor treatment not only leads to loss of vision but can result in removal of the eye with severe social and economic costs for the individual. Many ophthalmology practices, including those in well developed countries, have limited access to routine microbiology services. When such facilities are available, traditional techniques such as culture and microscopy are not sufficiently set up to help identify eye pathogens. Current approaches using culture can take up to 3 weeks to identify organisms; Polymerase chain reaction may help for certain non-bacterial pathogens but newer technologies, such as rapid sequencing for bacteria, still require several hours of processing, are expensive and require larger volumes of liquid, and so are not viable for the teardrops of



Dr Parwez Hossain with eye infection exhibit at 2017 NAMRIP Conference


Diagnostic device developed by the team

ophthalmic practice. As a result, a high number of patients receive inappropriate antibiotic therapy and this risks being a factor in countries where antimicrobial resistance patterns are being seen in ophthalmic practice.

Use of the NAMRIP team's electrical impedance device provides an opportunity to reduce the time to identify an infection to just a few minutes, allow repeat sampling and enable infection monitoring. The lack of sample preparation and requirement of low electrical power allows use of the device in developing countries where limited refrigeration facilities and problems with regular electrical power supply may exist.

Professor Hossain, went on to win the 2017 Founders Cup for the device, awarded at the 101st Oxford Ophthalmological Congress in Oxford, and in 2018 has been awarded the King James IV Professorship by the Royal College of Surgeons of Edinburgh. The next step, having already received ethics approval, is to run a pilot study on patient samples and validate them against the model. The project has a flourishing collaboration with the Christian Medical College in Vellore, India and Lighthouse Eye Centre, Mombasa, Kenya enabling expansion of the technology into lower middle-income countries. Two journal papers have been published and follow-on funding secured from the Medical Research Council, Global Challenges Research Fund and the Royal College of Surgeons, Edinburgh, is enabling continued development of the device. Team members: Parwez Hossain, Myron Christodoulides, Hywel Morgan, Daniel Spencer, Maria del Mar Cendra and Alison Hill.

Engineering approach to tackle tuberculosis

Tuberculosis (TB) remains a major global pathogen, killing over 1.5 million people a year in the developing world, more than any other infectious disease. After meeting at a NAMRIP networking event, Professor Paul Elkington's Tuberculosis research group in Medicine and Dr Xunli Zhang's group in Engineering collaborated through NAMRIP pump priming to address the global challenge of drug-resistant tuberculosis by combining advanced cell culture methodology and microfluidics. The system they developed allows drug concentration to be varied over time and mimics changes that occur in a patient after taking antibiotics, which allows more accurate modelling of conditions in patients. It takes the testing system for resistance from the 2D petri dish to an engineered 3D platform that more closely resembles the real world. This system has the potential to be applied to a wide range of pathogens, not just TB.

Professor Elkington commented, "The opportunities that arose were the ability to synergise Dr Zhang's microfluidic and manufacturing expertise with our cell culture system, and the sum of the 2 parts is greater than the individuals".

The team are collaborating with the Indian Institute of Technology (IIT) Kharagpur, India. Professor Elkington has received £349K follow on funding from the MRC Global Challenge Research Fund Foundation award (MR/P023754/1) enabling a joint project between the team and the Africa Health Research Institute (AHRI), Durban, South Africa. Dr Xunli Zhang, having attended the ESRC UK-India AMR Sandpit in New Delhi, has also secured follow on funding from ESRC to continue development of this work. Outputs from the project have been published in the Journals mBio and eLife.

Team members: Xunli Zhang and Paul Elkington.

Dr Magdalena Bielecka demonstrating the fluidic system developed by the team

Healing wounds

Led by Professor Tim Leighton, this project brought together academics from Engineering, Biological Sciences, Health Sciences and Geography. Pump priming funds enabled testing, for use in low- and middle-income countries, of the ultrasonic device, StarHealer, to show that it could generate wound healing, in addition to wound cleaning, using just saline. This technology formed the basis of a collaboration with the Navrongo Health Research Centre in Ghana. With further support of £25K from an EPSRC GCRF Institutional Sponsorship award, Professor Leighton visited Navrongo in March 2018 to scope out the challenges the design must overcome, such as water supply and power, to enable deployment of StarHealer. The long-term vision is to add StarHealer to the equipment that travelling nurses in rural Ghana carry on their motorbikes so that they can make a difference to newborn mortality rates in rural areas. Community nurses have been equipped to ride motorbikes into remote rural areas as part of the Ghana Heath Service's Community-Based Health Planning and Services (CHPS) programme. The team also won a Commonwealth Professional Fellowship Scheme (CPFS) award, which contributed to this activity, by enabling Dr George Wak from Navrongo, to visit Southampton for 3 months to support knowledge exchange between the INDEPTH network and NAMRIP.

Prof Tim Leighton (l.h.s) and Dr George Wak (r.h.s) meeting with nurses in Navrongo, Ghana

Whilst funds are being sought to advance the Navrongo project, StarHealer is also being developed for trial in the NHS. Here in the UK, there are 6000 diabetes related amputations each year due to the failure to sufficiently clean uclers (mainly of the feet), costing the NHS £1 Billion every year. Other conditions (venous ulcers in the elderly, burns etc.) add to the volume of activity requiring accelerated healing. The team were awarded an MRC Confidence in Concept pump-priming grant to assist them in translating Starhealer for NHS applications. At The Royal Society's 'Labs to Riches' dinner on 20 March 2018, His Royal Highness, The Duke of York, presented Professor Leighton with the Royal Society's Lord Leonard and Lady Estelle Wolfson Foundation Translation Award, for the StarHealer invention, and the prize money from this is also supporting the translation of StarHealer into the NHS.

Team members: Tim Leighton, Christopher (Kit) Harling, David Voegeli, Jim Wright, Tom Secker, Craig Dolder, Mawuli Dzodzomenyp, Clare Plack, Bill Keevil and Mengyang Zhu.

StarHealer is part of a suite of inventions by Professor Leighton in the field of infection prevention and therapy. A new company, Sloan Water Technology Ltd., has been established to commercialise and manufacture Professor Leighton's inventions, having purchased his patents from the University, a deal which also funds the current admin costs of NAMRIP.

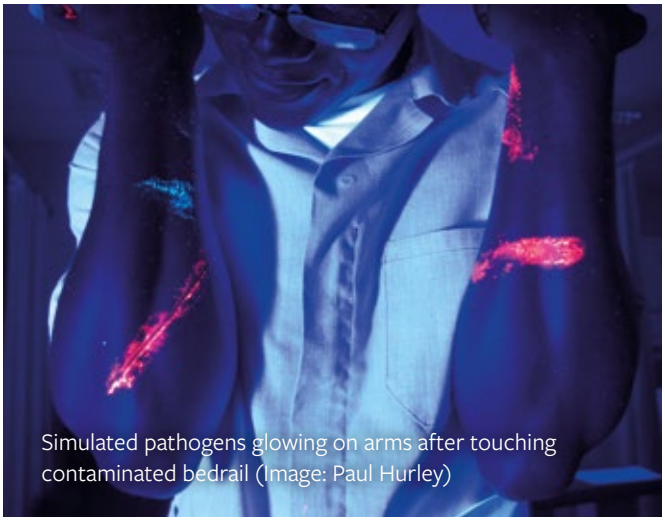
Tracking infectious agents in a hospital ward

Led by Dr Emma Roe, this collaboration grew when geographers, engineers, microbiologists and health scientists met at a NAMRIP networking meeting. It brings together imaging technology, nursing studies and cultural geography expertise. In addition, the project uses creative methods from visual arts and performance studies to create its outputs. The aim of the project was to use digital imaging technology to track human and microbial activity within a hospital ward. It enabled researchers, working with nurses, to visualise pathogens, touch encounters and risk, and to think about their relationship with infection risk and transmission. From their findings, a short film: "In our hands", made by filmmaker, Joseph Turp was uploaded to YouTube. The film incorporates poetry by Michael Rosen and one of the nurse collaborators took part as an actor. It has been screened for staff and visitors at University Hospital Southampton, Southmead Hospital, Bristol, the Royal Society, UK Government Department of Health and Social Care, and at Global-NAMRIP meetings in Ghana and Uganda After translation into Polish it has been presented at the 'Safe Hospital of the Future' 2017 conference in Krakow.

Team members: Emma Roe, Charlotte Veal, Paul Hurley, Jacqui Prieto, Lisette Schoonhooven, Sandra Wilks, Xunli Zhang and Robert Smizan.

The 'In our hands' film can be viewed on YouTube:
www.youtube.com/watch?time_continue=5&v=W7xnaXSJabo

As a follow-up, in collaboration with Wallgate Ltd and artists Matthew Olden and Will Datson, the team developed a prototype video display station, incorporated into an automatic hand washing machine. The installation aims to help broaden the impact of hand hygiene awareness. It has been exhibited at Winchester Science Centre, Cheltenham Science Centre and the 2017 NAMRIP conference where keynote speaker, Lord O'Neill highlighted it in his presentation.



Simulated pathogens glowing on arms after touching contaminated bedrail (Image: Paul Hurley)

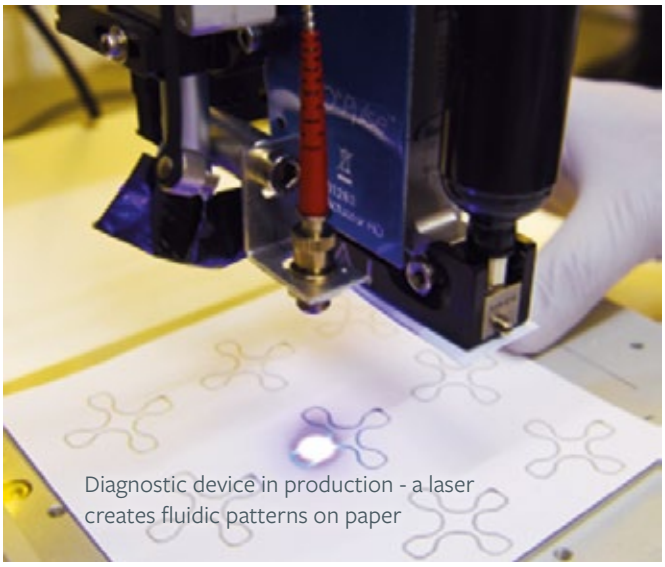
Developing a paper-based diagnostic test

A NAMRIP networking event brought together a team from Optoelectronics, Engineering and Medicine to develop a low cost, rapid diagnostic test to detect the early stages of infection.

Early diagnosis and prompt treatment with the correct antibiotic is critical for a patient's recovery and prevention of antibiotic resistance. However, it currently takes 2-3 days of culture testing within a laboratory to determine which bacteria are causing an infection, and their sensitivity to different antibiotics. Therefore doctors prescribe antibiotics according to guidelines based on the most likely causative organism, and local or national data on antibiotic sensitivity. Multidrug resistant organisms are becoming commoner (particularly in urine infections), so patients often do not improve with the first antibiotic prescribed. If the specific microbes causing the infection could be identified quickly, doctors could prescribe the best antimicrobial from the outset. Using laser technology, Dr Collin Sones' team have developed a paper-based diagnostic whose principle of operation resembles the 'dipstick' technology used in pregnancy tests. The project results were presented at international conferences with published conference proceedings. Team members: Collin Sones and Bhaskar Somani.

Following a meeting between Dr Sones and Professor Jane Davies from UCL at NAMRIP's 2017 summer conference (where Professor Davies was a guest speaker), the new collaboration successfully secured funding of £967K (EP/P025757/1) to further develop point-of-care infection detection. The team also secured partnerships from different industry partners.

In October 2018, £540K of funding was secured via another grant (EP/S003398/1) to develop the next generation of paper based diagnostic devices. Led by Professor Robert Eason with Dr Collin Sones and Professor Paul Elkington the team established links across disciplines via the NAMRIP network.



Diagnostic device in production - a laser creates fluidic patterns on paper

Activities & Events

2015-2017

The EPSRC 'Bridging the Gap' grant enabled NAMRIP to hold over 60 events. This included monthly theme workshops, providing members with the opportunity to share their research and meet new members. A number of new collaborations were established as a result, many of which went on to submit successful grant applications and conduct ground-breaking research.

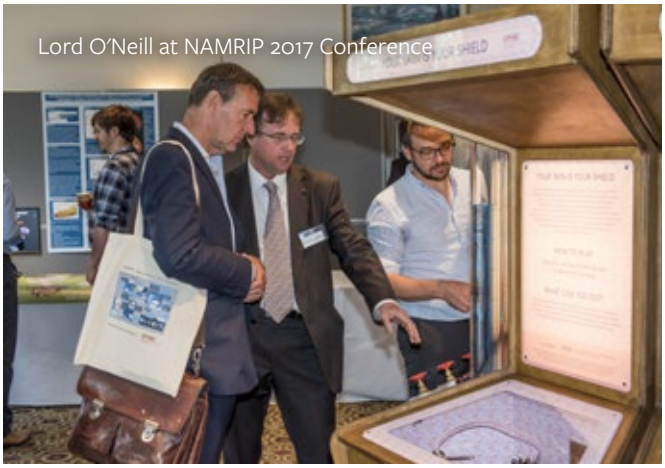
A key feature of all events was that presentations should be jargon free so that an engineer could understand a talk by a clinician and vice versa. Not easy! To enable this a workshop 'Beating infections without jargon' was developed by NAMRIP's public engagement team and has since been replicated outside of the network.

Our launch and summer conferences were particular highlights enabling NAMRIP members to engage with those outside the University including industry and policy makers.

The launch conference and exhibition on 14th December 2015 was attended by over 170 people including academics from a wide range of disciplines, fellow 'Bridging the Gap' colleagues from across the UK, policy makers, sixth form students, research councils representatives and partners from industry. Our high profile keynote speakers were Dame Sally Davies (Chief Medical Officer) and Professor Guy Poppy (Chief Scientific Advisor to the Food Standards Agency). They had the opportunity to tour the exhibition meet researchers and see at first hand the various inventions and research projects underway. This included a chance to capture microbes from flow to aid diagnosis and to try out the MicroGuide app which helps doctors prescribe the most appropriate antibiotic.

The NAMRIP Summer Conference and exhibition on 5th June 2017 was a huge success. This was an opportunity to share the results of a wide range of AMR research pump priming projects. Over 100 delegates attended the conference with presentations from 20 project leads. Lord O'Neill, tasked with chairing the review on Antimicrobial Resistance for the Government, opened the conference and Lord Selborne, who has chaired the Science and Technology Committee in the House of Lords, closed proceedings. Both had the opportunity to speak to exhibiters before their presentations.

NAMRIP Summer Conference 2016



Lord O'Neill at NAMRIP 2017 Conference

Dame Sally Davies 'capturing bacteria' with Dr Peter Glynne-Jones at NAMRIP 2015 Launch Conference

A tour of the National Biofilms Innovation Cente (NBIC). Left to right: Phil Packer (Innovate UK), Robert Hull (NBIC), Prof Jeremy Webb (Co-Director NBIC), Dr Jessica Boname (Medical Research Council) and Dr Stephen Webb (Biotechnology and Biological Sciences Research Council)

2018

The conference programme in 2018 reflected the way NAMRIP has become sustainable and self-funding, at its current size, beyond the 2-year EPSRC start-up grant. The summer conference in 2018 highlighted the funds won to replace EPSRC's provision of pump priming funds. These new funds include a Confidence in Concept grant from the MRC into which NAMRIP members can bid for translation projects, and the funding of two large centres in which NAMRIP has a major role. These are the National Biofilm Centre (£12.8 million from BBSRC and Innovate UK with industry match-funding) and the Biomedical Research Centre (£15 million from NIHR). At our 2018 summer meeting the sponsors of these organizations met NAMRIP members, and the directors outlined how they can provide funds for NAMRIP members to conduct research through small-to-medium sized projects and fellowships. Preceding the conference, the Research Council sponsors enjoyed a day touring the National Biofilms Innovation Centre (NBIC), the Southampton Biomedical Research Centre (BRC) and Concepts in Confidence (CIC) facilities, meeting the academics involved in AMR research. Included in the whistle stop tour was a visit to Winchester Science Centre to see the NAMRIP exhibit in action.

The original EPSRC grant provided pump-priming funds (replaced by the grants described above), funds for administrative support (now provided by NAMRIP's first spin-out company, Sloan Water Technology Ltd, and follow-on research grants), and funds for networking. The latter were replaced in 2018 with the EPSRC Impact Acceleration fund and EPSRC GCRF Institutional Sponsorship award which supported NAMRIP's first Global-NAMRIP conference, in Accra, Ghana in March 2018. Nine NAMRIP members from Southampton joined 60 invited delegates from Ghana, Uganda and Malawi. The first day of the conference saw presentations from both Southampton and African delegates on their research tackling AMR. The following day provided an opportunity for conversations and discussions between the academics, government organisations and policy makers with the aim of identifying new collaborations and research opportunities in areas such as infection prevention and new diagnostic technologies in low- middle-income countries.

Global-NAMRIP Conference 2018 in Accra, Ghana

Prof. Xunli Zhang and delegate at Global-NAMRIP Conf 2018

Raising public awareness of AMR

From talking to members of the public in pubs through the 'Pint of Science' initiative to meeting with Members of Parliament, NAMRIP members have been active in spreading the word about AMR and the diverse ways in which they are tackling the issue. Training in using jargon free language, developed in the early stages of the original EPSRC NAMRA grant, aimed to enhance communication with the public. There have been many opportunities to put this into practice in dialogue with sixth form students, policy makers, hospital staff, science societies and speaking with members of the public at University Roadshow exhibitions including BBC Countryfile Live and Camp Bestival.

The media have called upon NAMRIP members on numerous occasions for their expertise around AMR. Articles have featured in magazines including the 'New Scientist' and 'Science in Parliament' along with radio interviews including one live from Navrongo in Africa.

More information on NAMRIP's Public Engagement and Public Policy activities can be found on the NAMRIP website:
www.southampton.ac.uk/namrip/publicengagment/index.page
www.southampton.ac.uk/namrip/publicpolicy/index.page

Making microbe masks at Camp Bestival

AMR Exhibit at Winchester Science Centre

The first action point from Lord O'Neill's government review into AMR was that a global public awareness campaign is required to educate everyone about the issue, in particular children and teenagers.

Directly addressing this point, NAMRIP's AMR exhibit, developed jointly between NAMRIP and Winchester Science Centre, was launched at the Winchester Science Centre in February 2017 during school holidays. When not on loan at events, 'The Most Dangerous Game in the World' is on permanent display at the Centre and has been seen by thousands of adults and children. The aim of the exhibit is to raise awareness of AMR and share in a fun way how we are tackling this major issue. Children can play the themed games while adults read the key messages behind each one. There is an opportunity to sign up to an age-appropriate pledge using an old fashioned typewriter. Pledges include those where adults make a commitment to complete the full course of any antibiotics they are prescribed, and children wash hands for a duration of 2 rounds of 'Happy Birthday' to prevent the spread of infection. This last pledge was visible at the Cheltenham Science Festival when a visitor to the exhibit reported that the toilets had all morning been full of children singing the song!

"The Most Dangerous Game in the World" at NAMRIP Conference 2017

Lots of interest in NAMRIP exhibit at the London Science Museum in 2018.

Designed to be easily transported and set up, the exhibit has been on tour to the Cheltenham Science Festival, University of Southampton Science & Engineering Day, London Science Museum Lates 'Superbugs' event, The New Forest Show and the Longitude Prize 'Superbugs' event.

The exhibit was highly praised by Lord O'Neill who played its games at the NAMRIP Summer Conference. It was also mentioned in Parliament by Steve Brine, Under-Secretary of State for Public Health in his speech in Parliament during a debate on World Antibiotics Awareness Week.

What next for NAMRIP

In 3 years NAMRIP has become self-funded for its current administration costs, but that leaves two major un-met ambitions.

Global NAMRIP

In the period 2015-2018, as NAMRIP launched pump-priming projects and established its membership in the UK, measures were taken to address AMR in low- and middle-income countries (LMICs), which will be disproportionately affected. Collaborators in Brazil, Argentina, China, India, Malaysia and particularly sub-Saharan Africa were created as NAMRIP transitioned to Global-NAMRIP to address this need. The first Global-NAMRIP conference was held in Accra, Ghana, and 10 pump-priming projects were funded to start international collaborations between Global-NAMRIP members. A Steering Committee has been set up with members from 10 countries. The African Committee members held their inaugural meeting in March 2018 and a follow-on meeting is planned for March 2019 in Uganda. Funding the Global-NAMRIP networking activities, and further research projects and their translation is a major goal.

Global-NAMRIP Conference in Accra, Ghana in 2018

The next generation

A dedicated programme to train up the next generation of researchers is NAMRIP's second ambition. These young people are out there, in labs equipped for the challenges of 15 years ago, training by senior staff who themselves were shaped by the challenges of the 1990s, in departments bounded by discipline perimeters invented to reflect thinking a century old. A major goal is to train up the next generation of researchers to lead against the challenges of 2030-2050, people comfortable with working across discipline boundaries and learning skills outside the set encompassed by their own degrees.

How to engage with NAMRIP

You can find more information about the research projects and activities described in this brochure, and keep up to date with the latest news from NAMRIP, by visiting our website www.southampton.ac.uk/NAMRIP

Academics

Our members are drawn from researchers and students across the world, all wanting to tackle the threat of AMR. New members are always welcome. Please email NAMRIP@soton.ac.uk if you would like to join NAMRIP or discuss collaboration.

View our list of members on the NAMRIP website:
www.southampton.ac.uk/namrip/about/members.page

Industry

Our links with industry ensure that solutions developed in the lab can be scaled up for implementation in the real world. A number of studentships have been secured with companies, including Vitacress and GlaxoSmithKline.

We are always keen to work with industry partners to translate our research. To discuss options for working together, please contact us on NAMRIP@soton.ac.uk so we can help you get in touch with the most appropriate team.

Appendix 1

Pump Priming Projects funded via EPSRC NAMRA grant

Call		PI	Co-Is	100% FEC	Co-funding	Project Title
Round 1	**1**	S Dennington (FEE)	M Fader (FHS), CW Keevil (FNES), S Wilks (FNES), R Wood (FEE)	£6,000	£1,187	Evaluation of cross-linked quaternised polyethyleneimine as a potential antimicrobial catheter material
	2	X Zhang (FEE)	P Elkington (FoM)	£21,691	£19,437	Integrating the 3-dimensional bioelectrospray cell culture model with a microfluidic platform to model real-time physiological changes
	3	C Jackson (FoM)	P Lackie (FoM), B Linclau (FNES), R Szpera (FNES), E Adam (UHS), RN Allan (FoM), R Howlin (FoM/ FNES)	£14,924	£0	Does fucose inhibit Pseudomonas aeruginosa colonisation of ciliated airway epithelium?
	4	R Allan (FoM)	S Faust (FoM), S Dennington (FEE), P Stoodley (FEE)	£22,661	£0	Prevention of Pneumococcal Biofilm Formation on Tympanostomy Tubes to Combat AMR
Round 2	**5**	D Voegeli (FHS)	T Secker (FNES), CW Keevil (FNES), T Leighton (FEE)	£24,488	£2,489	A pilot study to evaluate the efficacy of an ultrasonically activated water stream for wound cleaning of antimicrobial resistant biofilm infections
	6	M Christodoulides (FoM)	I Tews (FNES), M de Planque (FPSE)	£15,042	£0	Crystal structure of the Neisseria gonorrhoeae adhesin complex protein (Ng-ACP), a vaccine antigen for preventing infection by antibiotic resistant bacteria.
	7	L Goodes T Secker (FNES)	M Zhu (FEE), T Leighton (FEE)	£17,255	£5,939	Ultrasonic cleaning of real world contaminated floor surfaces
	8	T Secker (FNES)	M Zhu (FEE)	£23,828	£0	The effect of surface roughness on the attachment and removal of MRSA and prion-associated amyloid from surgical surfaces
	9	S Khalid (FNES)	M de Planque (FPSE)	£13,978	£0	A multidisciplinary platform for studying antimicrobial peptides: bridging the gap between the in vitro and in silico regimes
	10	S Wilks (FNES)	J Prieto (FHS), D Voegeli (FHS), CW Keevil (FNES), M Fader (FHS), T Leighton (FEE)	£24,744	£8,438	A pilot study to evaluate the effectiveness of StarStream for surgical hand disinfection
	11	S Yang (FEE)	E Roe (FSHS)	£2,500	£500	3D Printing of cow's shoe
	12	C Sones (FPSE)	B Somani (FoM)	£11,171	£9,430	Enabling testing of Antimicrobial Resistance to antibiotics via laser-patterned paper-platforms
Round 3	**13**	M de Planque (FPSE)	T Newman (FoM)	£14,363	£0	Delivering antibiotics with nanoparticles: what drives the binding of polymersomes to cell membranes?
	14	E Roe (FSHS)	J Prieto (FHS), L Schoonhooven (FHS), S Wilks (FNES), X Zhang (FEE), P Hurley	£19,372	£500	Preventing the spread of infection in hospital care settings: Health professionals, the agency of microbes and imaging tracking technology.
	15	S Wilks (FNES)	O Katsamenis (FEE), M Fader (FHS), B Keevil (FNES), X Zhang (FEE)	£16,772	£2,934	Using micro computed tomography (micro CT) to understand crystalline biofilms in urinary catheters
	16	R Herve (FNES)	R Zmijan (FEE), X Zhang (FEE), B Keevil (FNES)	£23,833	£0	Examining and optimizing flows in endoscope working channels to improve reprocessing efficacy using cold atmospheric plasma
	17	T Leighton (FEE)	S Dancer (NHS), M Tooley (NHS)	£665	£5,716	Testing StarStream in two hospitals outside of Hampshire
Round 4	**18**	E Roe (FSHMS)	I Williams (FEE), A Viens (FBL), O Jones (Bath), P Hurley (FSHMS)	£24,654	£0	Fighting superbugs on the home front: becoming an ecological citizen in your bathroom.
	19	M Lowe (FBLA)	E Roe (FSHMS), N Wrigley (FSHMS), A Hughes (Newcastle), T Cherrett (FEE), B Keevil (FLS), T Leighton (FEE)	£5,670	£2,472	Food retail supply chains and AMR: Scoping workshop with Food Standards Agency
Round 5	**20**	J Kanczler (FoM)	J Dawson (FoM), P Schneider (FEE), B Sengers (FEE), R Oreffo (FoM)	£16,853	£0	Preventing bone infection in bone graft augmentation and impaction bone grafting

Call		PI	Co-Is	100% FEC	Co-funding	Project Title
Round 5	**21**	R Allan (FOM)	B Linclau (FNES), S Faust (FoM), C Fontenelle (FNES)	£14,366	£0	Development of rationally designed tagatose analogues as a novel treatment strategy for pneumococcal biofilm infections
	22	R Read (FoM)	A Vaughan (FoM), P Roach (FNES)	£12,255	£12,451	Identification and structural characterisation of a putative IgD binding protein in the outer membrane of Neisseria lactamica leading to translation as a strategy to maintain bacterial commensalism
	23	R Hull (FNES)	O Katsamenis (FEE), J Webb (FNES), S Clarke (FoM), D Cleary (FoM), S Faust (FoM), N O'Brien (FEE), R Howlin (FNES), P Stoodley (FEE)	£22,414	£5,208	Novel In-vivo Imaging of Antimicrobial Resistant Streptococcus pneumoniae Biofilms within the Galleria mellonella animal model
	24	M Cendra (FoM) P Hossain (FoM)	P Hossain (FoM), D Spencer (FPSE), M Christodoulides (FoM), H Morgan (FPSE)	£16,562	£0	Microbial Pathogen Detection in Ocular Infection Using Microfluidic Impedance Flow Cytometry (MIFC)
Round 6	**25**	T Leighton(FEE)	J Wright (FSHMS), T Secker (FNES), C Dolder (FEE), M Dzodzomenyp (Ghana), C Plack (FoM), M Zhu (FEE)	£30,023	£7,742	Development and evaluation of new technology for treatment of minor trauma in community-based healthcare
	26	D Cleary (FoM)	M Niranjan (ECS), S Clarke (FoM), M Elmore (PHE), S Pullan (PHE), Y.C.Chieng (Malaysia)	£16,948	£12,500	Application of rapid antimicrobial resistance surveillance and serotyping of Streptococcus pneumoniae in developing countries using novel genome sequencing technology
Round 7	**27**	C Dolder (FEE)	T Secker (FNES)	£17,016	£0	Engaging with cleaning
	28	R Herve(FNES)	N Gilbert (FPSE), R Eason (FPSE), B Keevil (FNES)	£16,476	£0	Adapting a borescope or fiberscope to assess residual contamination in luminal endoscope channels
	29	P Hurley (FSHMS)	E Roe (FSHMS), T Leighton (FEE), P White (FEE), J Prieto (FNES), S Wilks (FNES)	£17,420	£0	In Our Hands - Mapping Microbes App Development and Film Launch
	30	S Khalid (FNES)	M de Planque (FPSE)	£7,578	£0	First glimpses of antibiotics permeating through the bacterial cell envelope
	31	T Millar (FoM)	D Carugo (FEE), M Christodoulides (FoM), N Bressloff (FEE)	£26,468	£0	Infective endocarditis, biofilms and haematogenous spread of disease
	32	R Read(FoM)	J Laver (FoM), E Stulz (FNES)	£17,168	£15,584	A probiotic chewing gum for prevention of infectious disease
	33	D Carugo (FEE)	B Somani (FoM), A Mosayyebi (FEE)	£16,221	£0	A material-independent and patient-specific ureteric stent with increased lifetime and patient tolerability
	34	T Secker (FNES)	I Corni (FEE), N Symonds (FEE), B Keevil (FNES)	£19,324	£4,063	Antifouling metals, metal alloys and coatings for infection prevention
Round 8	**35**	D Carugo (FEE)	S Chakraborty (India), M Sutton (PHE), P Glynne-Jones(FEE), F Plazonic (FEE)	£14,277	£5,761	Ultrasound-enhanced treatment of multidrug resistant biofilms in chronic infections
	36	M Christodoulides (FoM)	C Sones (FPSE), V Humbert (FoM), E Coelho (Brazil)	£17,763	£3,353	Development of a rapid point-of-care serodiagnostic assay for visceral leishmaniasis based on laser-patterned microfluidic devices
	37	T Secker (FNES)	M Faoury (FoM), R Salib (FoM), T Leighton (FEE), C Dolder (FEE)	£608	£8,929	Pilot study to determine the efficacy of a novel ultrasonic nasal douche
	38	M Willcox (FoM)	Y-T Fei, X-Y Hu, R-Y Xia, B Graz, J-P Liu, B Stuart, L Lai, A Flower, M Moore, P Little, N Huang, X-R Hu, X Li	£10,000	£0	Retrospective treatment outcome study of treatment seeking for cough in China
	39	A Hughes (Newcastle)	E Roe (FSHMS)	£10,000	£0	Scoping Work on Global AMR Challenges and LMICs

Key

FEE: Faculty of Engineering & the Environment,
FoM: Faculty of Medicine,
FHS: Faculty of Health Sciences,
FNES: Faculty of Natural & Environmental Sciences,
FPSE: Faculty of Physical Sciences & Engineering,
FSHMS: Faculty of Social, Human & Mathematical Sciences,
FBL: Faculty of Business and Law & Art,
UHS: University Hospital Southampton,
NHS: National Health Service

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