100,000 GENOMES PROJECT

THE GENE GENIE

Revolutionising treatments for cancer and rare diseases — *p.14*

HISTORICAL MORTALITY

A HORRIBLE WAY TO DIE

Infection, plague and malaria in the English Civil War — *p.24*

EPIDEMIOLOGY

ZIKA VIRUS IN FOCUS

Global threat drives efforts to create a vaccine — *p.32*

THE BIOMEDICAL SCIENTIST

THEBIOMEDICALSCIENTIST.NET

JUNE 2017

ONE SMALL STEP

Biomedicine in space

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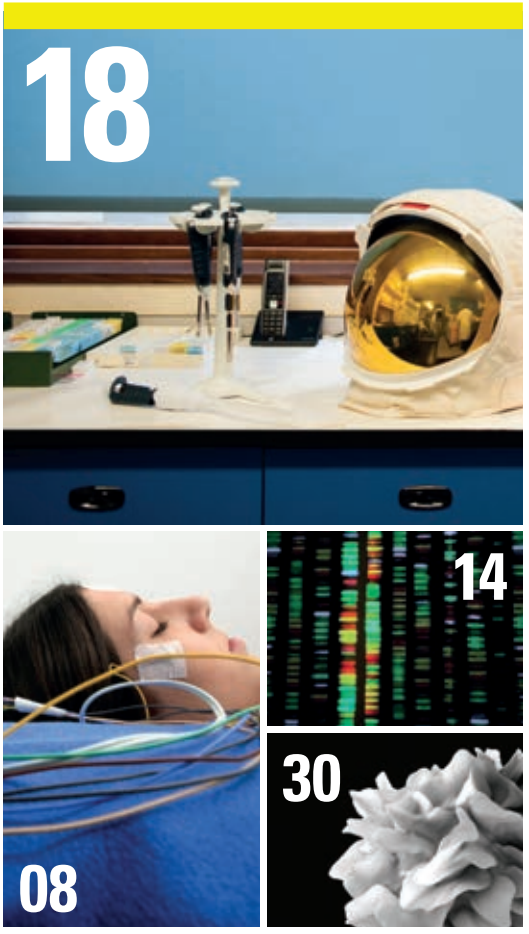

COVER PHOTOGRAPHY: RICHARD GLEED

EDITOR Rob Dabrowski

SENIOR DESIGNER Gary Hill

PICTURE EDITOR Akin Falope

PUBLISHING DIRECTOR Aaron Nicholls

PRODUCTION Rachel Young

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IS SILENCE GOLDEN?

With Congress just around the corner, it is vital to remember the importance of talking.

In this month's *Biomedical Scientist* we are carrying a feature on effective networking (see page 38) which, in an era of rapid change and the disappearance of the "job for life", is an essential skill. My concern is that as a profession we are probably not the best of networkers and do not have a vast amount of face-to-face networking opportunities.

I should probably confess that I intensely dislike the term "networking", as for me it holds connotations of somewhat superficial and contrived interactions. But the importance of good communication skills and the ability to recognise and effectively utilise communication opportunities cannot be underestimated. It is something of a paradox that in an era of multiple communication channels I am concerned enough about professional networking skills to write about it in this column.

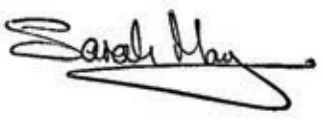
Texts, Twitter and emails are designed for rapid exchanges: views and responses captured in a handful of words and topped with a smiley or grumpy face. Facebook is fun and LinkedIn is serious (but essentially the same), so how do we best use these multiple options to ensure we are effective networkers and not just professional "pond skaters" that glide across the surface of proper conversation?

Personally, I think that the best starting point for building a network is to seek out spoken conversation opportunities. A number of years ago I was talking with a senior transfusion biomedical scientist who had recently changed job. In his new role, he made it his business to go walkabout during his lunch breaks, or in any other spare moment, to visit wards and clinics to find out what they did and to learn about their awareness of, and relationship with, the transfusion laboratory. Through talking to other professional people he was able to bring about changes that benefited his laboratory, the patients and clinicians they serve and, in doing so, he enhanced his own professional profile.

Where local networks are still active, they are extremely effective. There is no substitute for the group of people who share a common interest and continually reach out to their colleagues with support and friendship.

This month you will also see the updated Congress programme, and one of the benefits we emphasise is the networking opportunity it presents.

I think of it as the opportunity to have that one conversation that may really make a difference. It could even be the starting point for a new local network.



Sarah May
Deputy Chief Executive

IBMS

Institute of Biomedical Science is the professional body for the biomedical science profession.

INSTITUTE OF BIOMEDICAL SCIENCE
12 Coldbath Square
London, EC1R 5HL
United Kingdom
+44 (0)20 7713 0214
+44 (0)20 7837 9658
Email: mail@ibms.org
Web: www.ibms.org

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SCIENCE NEWS IN NUMBERS

The cost of a new blood test that has been developed which could help target treatment for men with advanced prostate cancer.

It follows **blood analysis from 256 men** with the disease, which found those with multiple copies of a particular gene did not respond to **abiraterone** and **enzalutamide** – drugs commonly used to treat advanced cases. The test, which is undergoing clinical trials, is hoped to be a **cost-effective way** of **preventing men from undergoing the side-effects of therapy** that will fail.

The Cancer Drugs Fund in England

1.27bn

It ran from **2010 to 2016** at a cost of **£1.27bn**.

100,000

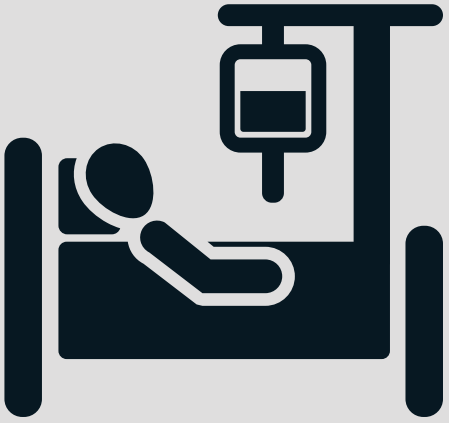
Nearly **100,000** patients received drugs under the scheme.

1 in 5

Only **1 in 5** of the treatments was found to be of benefit.

Just 18% met the internationally recognised criteria for being clinically beneficial.

54 years



A former soldier, believed to be the longest-serving patient in the UK, has passed away after 54 years in the same hospital.

James Morris was admitted to hospital with a broken leg in 1962 but **never went home** after suffering a **cardiac arrest** on the operating table.

59% of people in the UK had an alcoholic drink in the week before being surveyed by the Office for National Statistics.

The news is from a recent report that says more than **1 in 5 people do not drink any alcohol**. This is a total of around **10.6 million people** – an **increase of 2% since 2005**.

The results are based on a poll of nearly 8000 UK men and women.

£20bn

The Association of the British Pharmaceutical Industry has said that spending on health should rise from the current **9.9% of GDP** to the **G7 average of 11.3%** – a increase of about £20bn at current rates.

HEART DISEASE

"Non-O blood group increases risk"

People with a non-O blood group have a slightly increased risk of heart attack and stroke, according to new research.

It states that the reason for this could be higher levels of a blood-clotting protein in people with A, B and AB blood.

The findings from the research, presented at the World Congress on Acute Heart Failure in Paris, could help doctors better understand who is at risk of developing heart disease.

Lead author Tessa Kole said: "We demonstrate that having a non-O blood group is associated with a 9% increased risk of coronary events and a 9% increased risk of cardiovascular events, especially myocardial infarction. In future, blood group should be considered in risk assessment for cardiovascular prevention, together with cholesterol, age, sex and systolic blood pressure."

The study included 1,362,569 people from 11 prospective cohorts, described in nine articles, and a total of 23,154 cardiovascular events.

The researchers analysed the association between blood group and all coronary events, combined cardiovascular events, and fatal coronary events.

This included a total of 771,113 people with a non-O blood group and 519,743 people with an O blood group.

→ **bit.ly/BS_JuneNews1**

SCIENCE NEWS

VIROLOGY

HIV "SNIPPED" FROM ANIMAL CELLS

Scientists have proven that they can "snip" the HIV away from infected cells using state-of-the-art genetic editing technology.

Researchers at Lewis Katz School of Medicine at Temple University completely shut down the virus and eliminated it from the tissues of mice which had been transplanted with human immune cells and infected with HIV.

The experiment, led by Dr Wenhui Hu, follows on from the team's previous research, in which they managed to delete HIV-1 from the genome of most tissues.

Dr Hu said: "We confirmed the data from our previous work and have improved the efficiency of our gene editing strategy. We also show that the strategy is effective in two additional mouse models, one representing acute infection in mouse cells, and the other representing chronic infection in human cells."

The team is hoping to move to trials in primates, and eventually humans, which could be underway by 2020.

→ **bit.ly/BS_JuneNews2**

2020 **HUMAN** TRIALS COULD BE UNDERWAY AS EARLY AS **2020**, SAYS THE TEAM BEHIND THE RESEARCH.

CANCER RESEARCH

PREDICTING LUNG CANCER'S RETURN

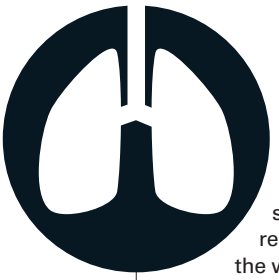
Unstable chromosomes within lung tumours increase the risk of cancer returning after surgery, it has been found.

Scientists at the Francis Crick Institute and University College London made the discovery and used the knowledge to determine relapse risk up to a year before the cancer returns.

The TRACERx lung cancer study, funded by Cancer Research UK, is the first to look at the evolution of cancer in real time and in such detail.

Researchers followed patients from diagnosis through to either disease relapse or cure after surgery, tracking and analysing how their cancer developed.

Charles Swanton, lead researcher, said: "The TRACERx study is Cancer Research UK's single biggest investment in lung cancer, and for the first time we've revealed new insights into how tumours evolve and evade treatment, a leading cause of cancer death.



"We believe that this invaluable data generated during TRACERx will be seized upon by research teams across the world, helping us to answer more questions about lung cancer biology. We've only scraped the surface in terms of what is possible."

→ **bit.ly/BS_JuneNews3**

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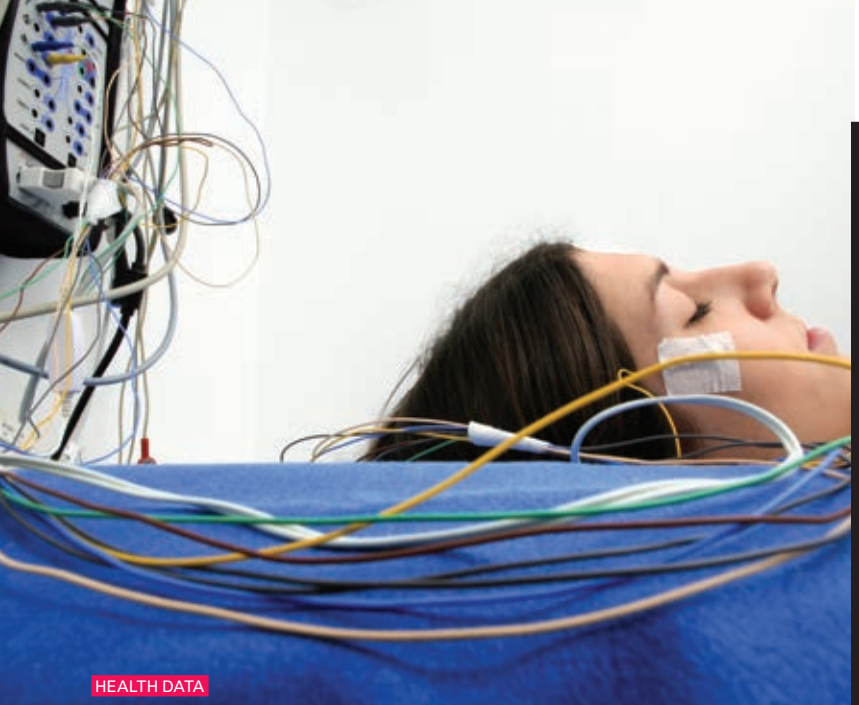


HEALTH DATA

GOOGLE STUDY UNDERWAY

Google's new health research project that will gather reams of data from 10,000 people has been launched.

Project Baseline, run by Google spin-off Verily, will look at the genes and microbiomes of US volunteers.

It will monitor their sleep, physical activity and wellbeing over a four-year period to learn about the onset and prediction of diseases.

Each volunteer will undergo a series of detailed medical tests every year, based on samples of blood, saliva and sweat. They will be given special watches to wear that track physical movement, heart rate and rhythm, and electrical conductance of skin.

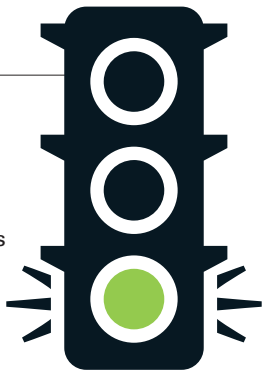
Bed sensors will monitor duration of sleep, and volunteers will fill in regular questionnaires on their health and completed cognition tests.

Verily says that all data collected will be anonymised, encrypted and securely stored. It plans to make the data available for free to potential partners who "want to contribute to the Baseline mission to understand health and the transition to disease".

→ **bit.ly/BS_JuneNews4**

BIOMEDICAL FACILITIES

£60M EXTENSION GETS GREEN LIGHT



A £60m extension to Citylabs biomedical campus has been approved by Manchester City Council.

It is a joint venture between science and technology park operator Manchester Science Partnerships and Central Manchester University Hospitals NHS Foundation Trust (CMFT).

The scheme, which will provide a mix of offices, laboratories and clinical space, is expected to create 750 jobs and is hoped to add more than £100m to Manchester's economy.

CMFT Medical Director Professor Bob Pearson said: "Citylabs offers a unique platform to involve clinicians and patients right at the start of the medical technology development and testing process, an approach that we believe is more likely to result in products that meet our needs. We are excited about the opportunities that this will bring."

→ **bit.ly/BS_JuneNews5**

WHAT'S HOT AND WHAT'S NOT

HOT

T'AI CHI

Regular moderate exercise, such as T'ai Chi, is recommended to those over 50 years old to improve brain function, says a study published in the *British Journal of Sports Medicine*.

HOT

UMBILICAL CORD BLOOD

A protein that is abundant in umbilical cord blood can rejuvenate learning and memory in older mice, according to a study by researchers from Stanford University.

HOT

SMARTPHONES

Chinese scientists have used a smartphone to control the activity of living cells. The fusion of biology and technology was used to control blood sugar levels in mice with diabetes.

NOT

TOBACCO

While smoking prevalence has decreased globally, deaths attributable to smoking have gone up by 4.7%. The study, published by *The Lancet*, says nearly one billion people smoke daily.

NOT

MEAT

Researchers from Cleveland say that the risk of blood clots increases with a meat-heavy diet. However, the research, published in *Circulation*, is based on a sample of just 18 people.

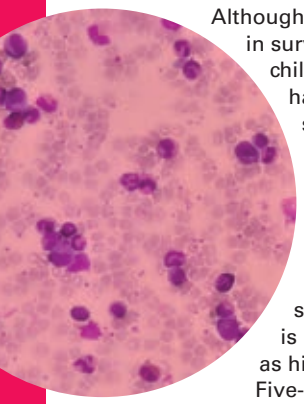
NOT

URBAN ENVIRONMENTS

A study of 57,000 Australian children, published in *Clinical and Experimental Allergy*, says people born in urban areas are more likely to suffer from nut allergies.

HAEMATOLOGY

"LEUKAEMIA INEQUALITY STILL AN ISSUE"



Although global inequalities in survival from childhood leukaemia have narrowed, they still persist, a new study shows.

The research in *The Lancet Haematology* says that five-year survival in some countries is nearly twice as high as in others.

Five-year survival for acute lymphoblastic leukaemia in Germany was 92%, compared with 52% in Colombia for children diagnosed in 2005-09.

The authors used individual patient data for almost 90,000 children, provided by 198 cancer registries in 53 countries.

"There is room for improvement in the management of childhood leukaemia in many countries," said lead author Dr Audrey Bonaventure of the London School of Hygiene & Tropical Medicine. "These findings show the extent of worldwide inequalities in access to optimal healthcare for children with cancer."

→ **bit.ly/BS_JuneNews7**

IMMUNOLOGY

Are lab mice effective for research?

Laboratory mice may not be effective models for studying immune responses to disease.

The claim comes in research into limitations of laboratory mice as immunological models.

Professor Mark Viney and colleagues from the University of Bristol and the London School of Hygiene & Tropical Medicine studied the immune systems of 460 wild mice taken from 12 sites in the UK. They compared them with mice bred in captivity.

The study found the two groups have major differences in their immune make-up, with the wild mice having highly activated immune systems.

Professor Viney said: "It is remarkable that despite the enormous number of studies of laboratory mice, ours is the first in-depth study of wild mice immune systems.

"What this shows is that wild mouse immune systems are working at 'warp-speed', compared with their lab cousins.

"These results point to us having to be much more cautious in extrapolating from the lab to the wild, but laboratory mouse models will continue to be hugely important in biological and biomedical research."

Across a total of 62 immunological measures, 57 differed between wild and laboratory mice, including wild mice having more highly activated myeloid cells – the bone marrow cells that initiate immune responses.

→ **bit.ly/BS_JuneNews6**

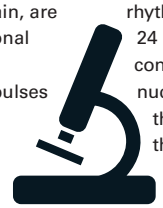
UNDER THE MICROSCOPE

This month: astrocytes

What are they?
Star-shaped cells that surround neurons. They are the most abundant glial cells in the brain, are closely associated with neuronal synapses and regulate the transmission of electrical impulses within the brain.

Why are they in the news?
Researchers from Washington University in the US have proven that they play a role not previously known – regulating the circadian rhythm and influencing the body's internal clock.

What was previously thought?
The regulation of the circadian rhythm, which lasts approximately 24 hours, was believed to be controlled by the suprachiasmatic nucleus – a region situated in the hypothalamus portion of the brain.



So, how many of these astrocytes do we have?
A lot – they greatly outnumber neurons, [often 10:1] and occupy 25% to 50% of brain volume.

If they are so abundant, why are we only just realising what they do?
Although these cells are anatomically obvious, their functions have been difficult to determine. Discoveries in the last 25 years, however, have revealed some of their roles and established the essential nature of interactions that take place between neurons and astrocytes for normal brain function.

What else do these astrocytes do?
They support the cells that comprise the blood-brain barrier, maintain the extracellular ion balance, supply nutrients to the nerve tissue and aide in post-traumatic repair processes.

IMAGES: ISTOCK

TECH NEWS

ROCHE DIAGNOSTICS

R&D INSIGHTS MEETING

Roche Diagnostics UK welcomed 30 healthcare leaders for its first Roche Diagnostics R&D Insights meeting.

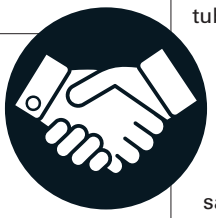
They met to discuss the adoption of new technologies in the health system.

Chris Hudson, Director of Healthcare Development and Strategic Services at Roche Diagnostics, said: "Our two-day Insights meeting has showcased some of the latest developments in technology, and how we are now working with health services to deliver these innovations in what is an exciting time for the life sciences sector. We call on the government to work with the NHS and industry to make sure that all eligible patients are able to have swift access to innovative medicines and diagnostics."

→ **roche.co.uk**

SIEMENS HEALTHINEERS

STRATEGIC PARTNERSHIP FOR MRI SCANS



Siemens Healthineers is joining forces with Imricor Medical Systems to develop an integrated solution that combines the clinical benefits of real-time MRI scans with 3D-guided cardiac ablation.

MRI-compatible devices are planned to be able to translate information on cardiac conduction, morphological substrates and individual patient anatomy into better treatment outcomes.

This approach will potentially enable electrophysiologists around the world to treat heart arrhythmia without radiation and to use the visualisation of soft tissue information obtained through MRI for this purpose.

→ **healthcare.siemens.co.uk**

GREINER BIO-ONE

COMBINED TUBES LAUNCHED

Following the successful launch of the new capillary blood collection system last autumn, Greiner Bio-One now presents the new MiniCollect Complete tube as the ideal complement to its innovative system.

For centrifugation, the MiniCollect tubes can be threaded into a premium carrier tube using a simple rotational movement.

In the Complete version, the MiniCollect tube is already irreversibly assembled in the carrier tube.

The combined tube means that both capillary and venous blood samples can now be analysed in the same way without complex modification of the device.

The tubes feature new caps, the membrane of which can be pierced by an analysis needle while the cap is closed, before automatically resealing after the needle is removed.

→ **gbo.com**

THE BIG QUESTION

THIS MONTH WE ASK

"Is science gender biased?"

Caroline Parkes

Quality and Training Manager
Kettering General Hospital NHS Foundation Trust

Online research shows there are over 300 measures of gender equality; bias, taken to mean a subconscious inclination, rather than a deliberate discriminatory act, is difficult to quantify. My experience of working in biomedical science for nearly 28 years has only been in an NHS laboratory environment, and only in one hospital. I have always had a far larger number of female colleagues than males. I've had four female and two male managers, and our Clinical Director is female.

I've promoted International Women's Day and taken part in an international "Celebrating Women" project. When asked this question, I began to think about gender bias in science globally, and compare it with my local and personal view. An interesting *Scientific American* blog post quoted a 2012 study in which otherwise identical job applications from scientists were given male and female names. The "females" were rated significantly lower in terms of both competence and hireability, and offered lower salaries.

In the NHS, ahead of much of the rest of the scientific community, HR policies are designed to make it very difficult to discriminate – perhaps others should learn from this. I personally feel that over the many years I've been a scientist (and a feminist), being female hasn't limited me or held me back in any way, while male contribution to the profession has been equally valued. A positive statement, without being a positive bias.

Valerie Bevan

Chair
British Society for Microbial Technology

First, some facts. Girls outperform boys in national exams, and more women than men study science at university and outperform them. However, the attrition of postgraduate women in science progressing to senior roles is high, and few women reach the top jobs. Using quantitative data from the Health Protection Agency, I have previously shown that the proportion of women scientists decreased as the pay grade increased. At the very top of science, just look at the low percentages of women who are elected to the Royal Society or who achieve Nobel Prizes.

Why does this happen? My research, using mainly qualitative interviews as the source data, illuminated many factors and I touch on one aspect here.

Society regards science and scientists as objective and rational, but this has been challenged by many studies that show scientists are just as likely to be biased as anyone else. Biases are harmful and there are many ways in which they manifest themselves. Biases affect women and men, but women suffer their effect more.

I regard subtle masculinities as the most invidious bias. Both female and male scientists have internalised this behaviour as normal and tend not to notice it happening. In practice this subtle sex discrimination means that men support and promote other men rather than women and exclude women from decision-making processes. Oh yes, science is full of gender bias. Read more about it in my forthcoming book, *Knowing Her Place: Positioning Women in Science*.

Nicola Hannam

Social Mobility Consultant
London

Yes, but progress has been made to remove bias specific to science. The world of work that evolved from factories and male breadwinners is no longer fit for purpose. We need new models of leadership, we need flexibility that benefits everyone – we need a revolution in the way we work. Both to catch up with the modern world and to harness the value added by diversity of perspective and approach, and not just gender diversity – none of us are defined by our gender alone. Vive la révolution!

We need new models of leadership, we need flexibility that benefits everyone

THE GENE GENIE

Professor Mark Caulfield, Chief Scientist at Genomics England, explains how advances in genomics research and big data are revolutionising treatments for cancer and rare diseases.

One child who participated in the 100,000 Genomes Project had exhibited developmental delay and suffered intractable seizures from the age of four months. By the time she was four years old, her parents had enrolled her in a number of research projects, but none were able to diagnose or treat her with any medicine.

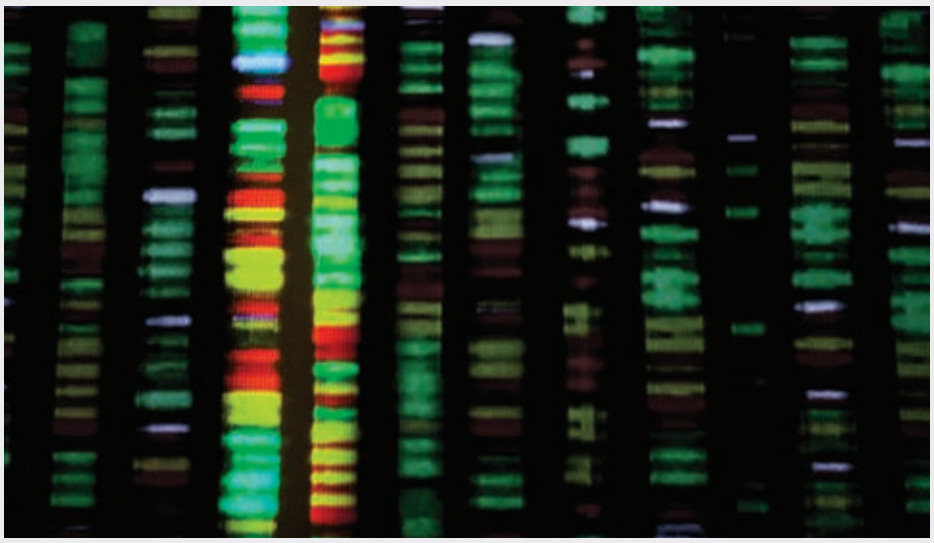
"We searched through the genome and found there was a mutation in a sugar transporter, and she was unable to take sugar into the brain. This triggered seizures because her sugar level was dropping," says Professor Mark Caulfield.

"The girl started to receive a high-fat diet – the brain has a mechanism to make sugar out of fat. Her seizures reduced and she showed some developmental improvement."

Her parents' genomes were sequenced as part of the project – to help make sense of the child's genome by filtering out anything unrelated to the disease – and the research team found that the child had a new mutation which her parents didn't carry.

"So they can now go on to try for another baby in the knowledge that it's extremely unlikely the same thing would happen. That's reassurance, which is one of the really important things in modern medicine," Mark adds.

Mark is Chief Scientist at Genomics England, the Department of Health-owned company in charge of the 100,000 Genomes Project, which is sequencing genomes from 75,000 people affected by rare and inherited diseases, cancer and infections. Every cancer patient will contribute two genomes – one from a healthy cell and one from their cancer – for comparison. Three genomes will come from rare disease patients – one from the patient and two from close blood relatives.



How it began

The "NHS transformation" project arose at the London 2012 Olympics when a group of scientists met then-Prime Minister David Cameron. "They advised him that the moment was right to transform the NHS so that genomics could be applied to health," Mark says.

It was nine years since the Human Genome Project had been declared complete, in 2003, and the ability to sequence had accelerated – where it once took years it was now possible to sequence a single genome in a day.

The government initially provided £186m and other commercial partners co-invested, including a sequencing partner Illumina, bringing the total estimated value of the project to £300m.

A further £50m a year for five years was promised in the 2015 Comprehensive Spending Review in order to "take the project to the next level and ensure that the genomics knowledge of the country could be concentrated in one place", Mark says.

"That would provide globally reliable datasets for people to work on, drive up the value for diagnosis and treatment in the NHS but also bring new medicines and diagnoses to test on this dataset in Britain. It draws inward investment into the UK – our mission is to deliver both for health and wealth gain for the country."

Overcoming challenges

But the infrastructure needed to carry out the work was not in place when the project began. Thirteen genomic centres of excellence around England, a sequencing centre and a data centre with a semi-automated pipeline to carry out the analysis were needed for the project.

"Each genome is on a big file – about 66 gigabytes. You can't just send these over the internet; you need to have a data centre," Mark says.

Embedding the project in the NHS – which covers 13 NHS Genomic Medicine Centres across 85 NHS trusts across England – has also been a challenge, now that the project has grown to cover Northern Ireland, Scotland and Wales.

Progress made

So far, the project has possession of 22,237 genomes, and over 30,000 people are enrolled in the programme. It has returned around 3,600 reports to clinical teams who care for patients with rare diseases, and about 500 cancer reports.

The project is linked to cancer drug trials which deploy medicines targeted at particular genetic mutations. Cancer reports highlight the mutation present in the genome and researchers can then suggest these particular drugs to the patient.

Diagnoses for rare disease have also increased by 20-25%. "We're bringing new answers to people who previously the NHS would not have been able to provide an answer for. We're stratifying healthcare by targeting the right therapy to the right patient at the first opportunity."

Participants have been "at the heart" of the project, Mark says. A participant panel sits on the projects' committees, such as the access review committee and ethics advisory committee, and holds the project's leadership to account of behalf of other participants.

Press coverage of the project has been generally supportive too. "Although we addressed an area which is difficult – combining big health data with genetic data – we've managed to avoid pitfalls, and that is down to the strong involvement of the participants."

ALL ABOUT MARK

- ✔ Mark graduated in medicine from London Hospital Medical College in 1984.
- ✔ He trained in clinical pharmacology at St Bartholomew's Hospital and developed a research programme in molecular genetics of hypertension and translational clinical research.
- ✔ He has directed the Barts National Institute for Health Research (NIHR) Cardiovascular Biomedical Research since 2008, and been an NIHR senior investigator at Queen Mary University of London since 2013.
- ✔ He is an NHS consultant in the Barts Blood Pressure Clinic within Barts/ William Harvey European Society of Hypertension Centre of Excellence.
- ✔ Mark is one of the top 200 most highly-cited genomics researchers in the world.

The future

The next phase of the project is to bring in 2,600 researchers to look at the data.

"Our duty is to get research communities, where we don't get a diagnosis initially, who will continue to work on this and drive up its value for healthcare and achieve diagnoses where there is a diagnostic need. Nobody has ever done this in this way before in genomics."

But genomics is just one part of the jigsaw. Mark sees the future of diagnosing and treating diseases with multiomics, including epigenetics. "What the genome is made into when it's translated by RNA into protein, into functions in the body – a multiomic approach will probably lead us to understand much better the architecture of disease." BMS

A DAY IN THE LIFE OF...

Ian Davies

I am a **Lecturer** in **Biomedical Science** at **Staffordshire University**, where I coordinate clinical placements and lead our new healthcare science programme. I am also a **Fitness to Practise Registrant Panel Member** with the **Health and Care Professions Council (HCPC).**

My first task when I arrive... is to check email and diary. Every day is different, so it's important that teaching, meetings and tutorials are all scheduled in. Next I scan through the news and social media – diagnostic stories quite often make the headlines, and it's great to feed these directly into teaching or debates to show how current and relevant the subject is.

One of the biggest challenges I face is... fitness-to-practise cases, especially when harm has been caused to patients. A lot of focus is needed to make sure that our decisions provide the necessary public protection but are also proportionate, and we acknowledge that mistakes happen.

My favourite thing about my job is... watching students grow, academically and personally, as they move from year to year. Graduation day is fast approaching – my favourite day of the academic year.

The thing that makes my job unique is... the ability to make wide connections between biomedical scientists, academics and students. One day I might be in London sitting on an HCPC panel, the next visiting a student on placement, the next discussing research opportunities.

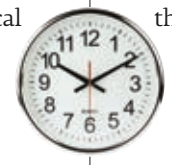
My route into the role involved... being a biomedical scientist in the NHS for 20 years. I then undertook a Postgraduate Certificate in Medical Education and started a teaching secondment in 2008. While working as a senior biomedical scientist and acting operational manger, I took part in the Clinical Academic Internship Programme, which prompted the move to a full time academic role.

I scribble down ideas and collect references to follow up when there's a pause in teaching

My typical lunch is... liquid (well, coffee anyway).

My job fits into the wider healthcare context... as biomedical scientists make a huge contribution to healthcare. By developing graduates with the correct knowledge and skills and encouraging innovation and development among experienced staff, the value of biomedical scientists to healthcare and to patients can be maximised.

If I get a few spare minutes then I... catch up on things. I scribble down ideas and collect references to follow up when there's a pause in teaching. With summer approaching, there will be time to develop some of these into plans for the next academic year.



I feel like I've had a good day when... the dots join up. Seeing one of those scribbles develop into a teaching session, new course or a potential project. BMS

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BIOMEDICINE THE FINAL FRONTIER

What is the future of biomedical research in space and what impact does this have on earth?

It is nearly 50 years since Neil Armstrong became the first man to walk on the moon. The historic moments were captured on camera and beamed live into an estimated 600 million homes around the world, the largest TV audience ever at the time. The distorted audio of his first faltering words – "that's one small step for man, one giant leap for mankind" – have become one of the best-known quotes in history.

The landing marked the pinnacle of the space race, which began on 2 August 1955, when the Soviet Union responded to a US announcement that it intended to launch artificial satellites by declaring they would also launch a satellite "in the near future".

While a latter-day rerun of the space race seems far-fetched, recent months have ushered in a renewed interest in exploring the universe. Donald Trump announced he would like to see US astronauts walk on Mars in his presidency, while Vladimir Putin has confirmed that work in Russia is underway to develop reusable rockets for space travel.

However, while the public focus of launching rockets into space is often a distant moon or planet, some of the most ground-breaking work done on these missions looks not to outer space, but to the inside of our bodies.

"It is a really big focus for us. We have four main types of research – human (or medical), biology, physics and technology. The medical projects take up most of the time, because for the other areas of research they tend to just have to press 'start' on the experiment and it will run its course," says Professor Jennifer Ngo-Anh, Head of Human Research Office at the European Space Agency (ESA). "However, for the human research, we ask the astronauts to experiment on themselves. They get in-depth training and know exactly what to do, but it still takes a lot more time than other areas of research."

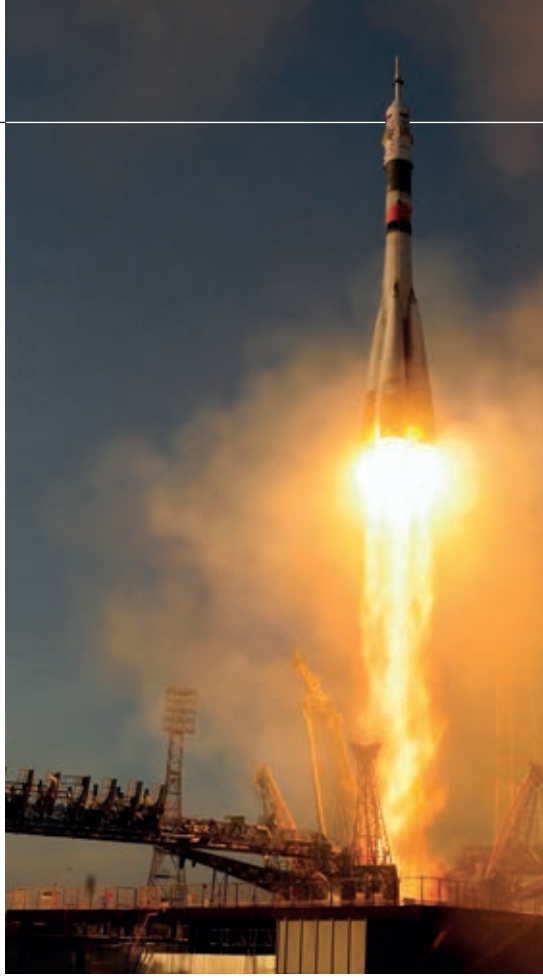
Medical experiments

She explains that on a trip to the International Space Station – which is 400km high and takes 90 minutes to orbit the earth – an astronaut may take part in up to 50 medical research experiments.

"With our research in space we want to advance knowledge on earth," says

PHOTOGRAPHY: RICHARD GLEED

With thanks to: Guy Orchard and colleagues at St John's Dermatopathology



Professor Ngo-Anh. "The astronauts are fully aware of what to do and get a detailed explanation. They don't have to participate in everything we ask them to do; however, we do ask them to participate in as much as they can. They also perform the experiments on the ground to get baseline data, before carrying out the experiment in space."

With so many different medical research projects being undertaken, which does Professor Ngo-Anh think could have the biggest impact? "We don't have a particular experiment that we are expecting to get the Nobel prize, but all the experiments have provided us with interesting results."

She cites an example of research carried out in space having a tangible impact on the ground. "Years ago, there was an experiment which used laser technology to look at certain parts of the eye. That experiment ran for five years and afterwards and it led to the technology being developed and is now used for eye refractive surgery."

Logistics in space

Five years may seem like a long time for an experiment to run, but the logistics of carrying out research in space throw up unique challenges. "It takes a lot of time for research projects to be completed – it can easily take a decade until enough astronauts have taken part in an experiment for the research to have a large enough sample size," says Professor Ngo-Anh. "Before scientists start an experiment with us, we make very clear that it is not like a normal lab experiment where they can have it all finished in one or two years."

However, they don't always take a decade. For example, at present ESA astronauts are taking part in the Airway Monitoring experiment, which looks at inflammation in lungs. The experiment began with ESA astronaut Samantha Cristofretti's 2015 mission and measurements have since been gathered by six astronauts, including the UK's Tim Peake (pictured right). Four more astronauts are due to conduct the experiment this year and data collection should be concluded by February 2018.

Among the main areas of human and medical research are muscle and cardiovascular health. Two areas of particular interest at present are the impact of long periods of bed rest ("when patients are in bed on earth, they are undergoing the same processes as astronauts in space with their muscles underutilised") and analysing the ageing process ("astronauts age much faster due to microgravity, so that's something very interesting for us").

Budgets and funding

This vast array of research does not come cheap, with the ESA's space science budget for this year totalling more than €500m for 2017. This is almost half the amount budgeted for launches, and four times more than the agency will spend on technology support.

Across the Atlantic, the expense of the research could be a major barrier for progress, with President Donald Trump slashing research budgets – the Environmental Protection Agency's has already been cut by 31% and the National Institutes for Health has lost 20%. Also, a proposed cut of 18% for biomedical research is currently making its way through Congress.

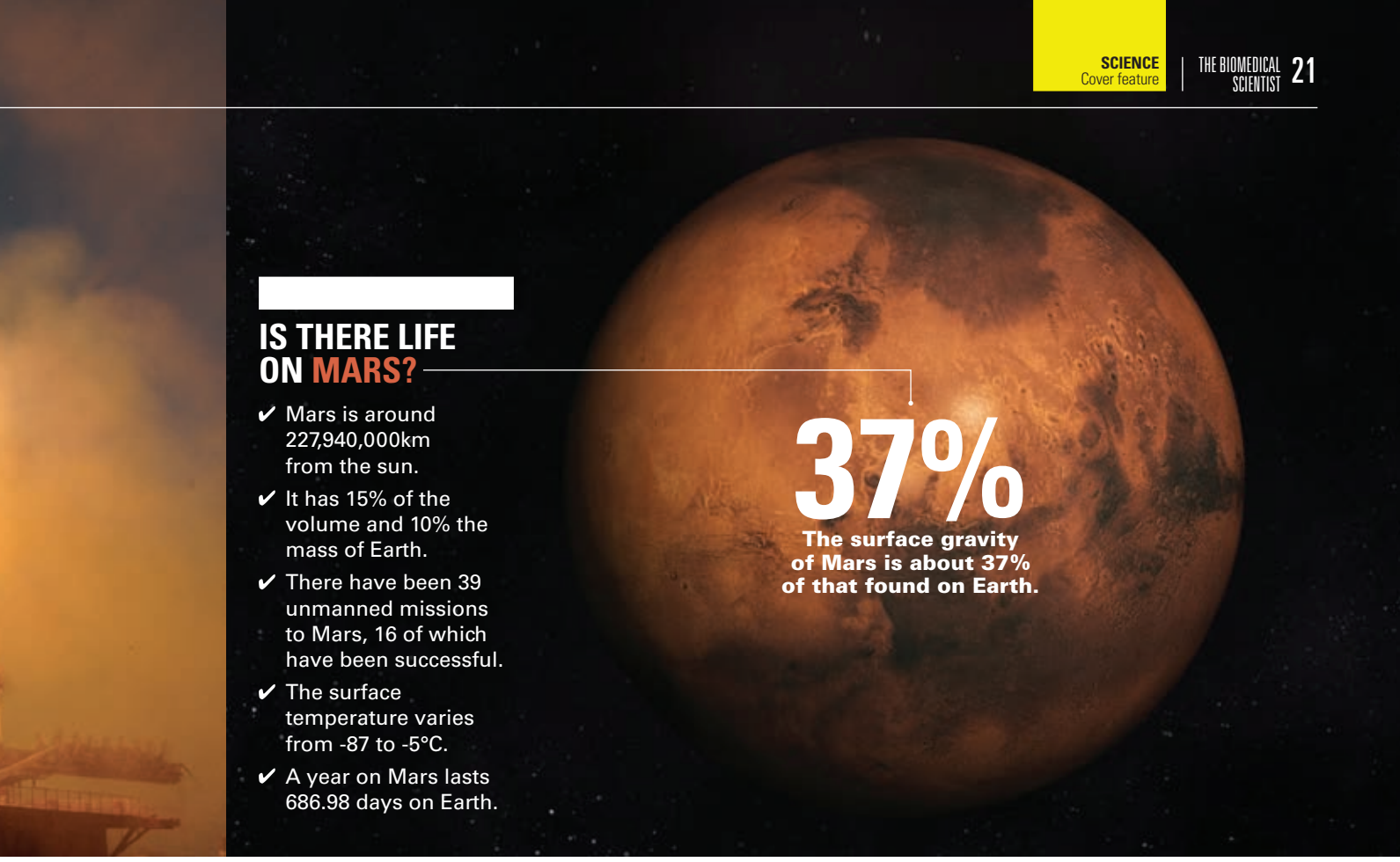
However, NASA has only shaved 1% off its budget, and speaking about his ambitions to send a crewed mission to Mars, President Trump said: "Well, we want to try and do it during my first term or, at worst, during my second term."

Professor Jeffrey P Sutton, President of the US National Space Biomedical Research Institute (NSBRI) tells *The Biomedical Scientist* he thinks the President's proposed timeframe is optimistic. "How about 2040?" he says. "It is very difficult to predict when this may take place. Much of the rocket science and technical expertise exists right now, although there is clearly limited experience of sending humans beyond low-Earth orbit. It will be risky and collectively the international community is relatively risk averse at this time."

He adds: "It will also be costly and require strong national leadership, vision and commitment to truly support and sustain such a bold endeavour. International collaboration will be a

THE EUROPEAN SPACE AGENCY

- ✔ The ESA was established in 1975 and has headquarters in Paris.
- ✔ Vladimír Remek became the first ESA astronaut in space in 1978.
- ✔ It comprises 22 member states.
- ✔ It has a staff of around 2,000.
- ✔ Its annual budget is €5.25b.
- ✔ The UK contributes 8.7% of this.



IS THERE LIFE ON MARS?

- ✔ Mars is around 227,940,000km from the sun.
- ✔ It has 15% of the volume and 10% the mass of Earth.
- ✔ There have been 39 unmanned missions to Mars, 16 of which have been successful.
- ✔ The surface temperature varies from -87 to -5°C.
- ✔ A year on Mars lasts 686.98 days on Earth.

37%

The surface gravity of Mars is about 37% of that found on Earth.

definite asset, and geopolitical factors are inherently unpredictable."

Earth-based benefits

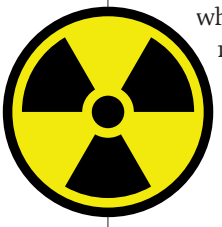
However, for a human to set foot on Mars is not the NSBRI's primary aim. "The most important aim is to lead a national effort for accomplishing the biomedical research necessary to support the long-term human presence, development and exploration of space," says Professor Sutton.

"In this regard, NSBRI plays a key pathfinder role for NASA in leveraging America's investment in biomedical research and bringing exceptional new investigators, institutions, resources and approaches toward mitigating high-priority risks associated with human space exploration. Another important aim of NSBRI is to apply the resultant advances in knowledge and technology to enhance life on Earth."

He goes on to explain that the vast majority of projects supported by NSBRI have "Earth-based benefit", in particular the Space Medical and Related Technologies Commercialisation Assistance Programme. "This focuses on small companies that develop and deliver products that have dual uses for health in space and on Earth."

Current work includes the testing of radiation protectants, which is hoped to benefit astronauts in space and oncology patients on earth. It involves creating uniquely formulated isoflavone – derived from soy – as a genomic stabiliser of healthy tissues exposed to medical radiation received during cancer therapy or from diagnostic procedures such at computed tomography scans.

As well as mitigating the debilitating gastrointestinal side-effects of commonly used oncology treatments, it could also be a countermeasure against radiation astronauts are exposed to – the number one health risk facing humans travelling in deep space.



Make the impossible possible

On the most exciting areas of biomedical research being conducted in space, Professor Sutton says there are "many areas that are exciting and require new innovative approaches to address some of the most interesting scientific and technical challenges of our time".

Alongside radiation countermeasures, he lists optimisation of cognitive and behavioural conditions, ensuring long-term storage and stability of medications, understanding the microgravity-associated ocular syndrome, and advances in human-system interaction design, among others.

"Space travel, whether robotic or crewed, is part of our collective destiny," he says. "It has and will continue to span multiple administrations of leadership and typically garners support across party lines. It is hard to know ahead of time what a particular administration might emphasise. However, there is no shortage of work that must be done if we are to push the frontier of what is possible."

While we may not be ready to send a manned mission to Mars yet, Professor Sutton believes these major milestones are important: "A human landing on Mars – that makes the seemingly impossible possible." Along the way, a raft of biomedical research will aim at both keeping astronauts safe in space and improving the health of people hundreds of miles below on Earth. BMS

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CONGRESS: MORE CONTENT ADDED

Sarah May, Deputy Chief Executive at the IBMS, looks at the new sessions that have been added to this year's Congress.

The updated Congress programme is launched this month and contains even more lectures and seminars than previously. For those who want to make the most of every minute that they spend at Congress, a number of programmes will start at 8.15am.

These early sessions offer the opportunity for joint and multi-discipline presentations. Regarding our Wednesday Quality Management programme, the early start was the only way we could cover everything we wanted to offer you in terms of content.

Exhibition hall seminars

The informal 30-minute seminars that are a popular feature, usually held in one of our lecture halls, have now grown to occupy a full three-day programme. These sessions cover a range of topics that are relevant to scientists of all specialisms and, therefore, may not fit in to a particular lecture programme.

Alternatively, it may be something so new that the main lecture programme was already full, so we have taken the opportunity to showcase it in our seminar programme.

Once again, we have invited biomedical scientist members of the armed forces, who will speak on delivering pathology services in a military context, to appear on the Wednesday.

Also on Wednesday there will be a presentation from Malcolm Robinson, the biomedical scientist founder of the Harvey's Gang charity that helps children with cancer to understand why all the blood tests are needed and what happens to their blood in the laboratory.

Health Education England is aware of the unique opportunity provided by Congress to interact with large numbers of biomedical scientists so, in addition to the molecular pathology presentations within the main lecture programme, it has requested taking two of the exhibition hall seminar sessions, in order to use every opportunity to tell our delegates about the progress of the 100,000 Genomes Project and its implications for pathology.

Introducing technology

During the Monday afternoon, a full programme of seminars will be given by some companies exhibiting at Congress that want to showcase their latest innovations.

These seminars are an opportunity for delegates to have an in-depth insight into the development and application of some of the new technologies available and to hear the views of other users.

Practical microscopy workshops

Don't forget to call the Congress helpline on **01892 779990** to book a place at one of the practical microscopy workshops, as places are limited.

Sunday afternoon will provide a timed workshop of 40 cytopathology cases consisting of urines, effusions and respiratory samples. This will be followed by a review of all the cases that will show the areas of interest and their diagnostic features.

On Monday afternoon we are offering a practical andrology preparation and microscopy workshop. This guided practical will take participants through the theory and practicalities of correct pipetting, counting and assessment of motility and morphology. Once again, these places are strictly limited and places must be booked. IBMS

EARLY BOOKING DEADLINE APPROACHING

Don't forget to take advantage of the early booking discounted rate, which ends on 30 June. For more information, visit **congress.ibms.org**

Fig. 1. The battle of Naseby, 14 June 1645.

A HORRIBLE WAY TO DIE

With diseases and accidents estimated to have taken more lives than combat in the English Civil War, **Stephen Mortlock** looks back at this death-stricken period of history.

"All the infections that the sun sucks up
From bogs, fens, flats, on Prosper fall and make him
By inch-meal a disease!"

William Shakespeare, *The Tempest*

The English Civil War (1642-1651) stemmed from conflict between Charles I and Parliament. The king believed in his divine right to govern without interference from Parliament, and it was this conceit and arrogance that would eventually lead to his execution. In 1642, after an abortive attempt to arrest five of his biggest critics on charges of treason, even Charles realised that things had broken down between the crown and Parliament. A week later, he left London for Oxford to raise an army to fight Parliament for control of England. A civil war was inevitable.

After the first, indecisive battle of Edgehill in 1642, Oliver Cromwell felt that a professional army would be more successful against the king, and the "New Model Army", which would become a military unit that transformed the subsequent battles, was formed.

Of course, raising and maintaining an army was not without problems; for almost all of human history, apart from the obvious dangers of warfare, the biggest toll of human life in war was taken by infectious diseases. During the conflict, historians believe that some 180,000 people died, but only 85,000 from combat – the rest were due to accidents and disease. So, although the actual death toll on the field might have been low, without modern medical care it was very easy for wounds that were received in the course of a battle to become infected, leading to blood poisoning and gangrene, which must have been a horrible way to die without antibiotics, anaesthetics or painkillers.

Some examples include Lt-Colonel Johnson of the Basing House garrison in Hampshire "shot in the shoulder whereby contracting a fever, he died a fortnight after"; Lt-Colonel Anthony Fane, a dragoon commander at the storming of Farnham Castle in Surrey "shot through the cheek(s), whereof he died a few days later". The cause of the fatalities was


2

probably the result of fragments of dirty cloth being driven deep into a wound, either beyond the reach of the surgeons' instruments or, more likely, being left there to fester.

Richard Wiseman (1621-1676), a prominent physician during the conflict and sergeant-surgeon to King Charles II after the war, best remembered for his book called *Severall Chirurgicall Treatises*, reintroduced cautery for wounds and recommended that gunshot wounds be bandaged with raw onions to counteract the effects of the gunpowder. He kept an account of a surgery performed after the battle of Weymouth in 1645: "A great Haemorrage happening to a Souldier at the Surprize of Weymouth by the Garrison of Portland, by a shot through the Heel, I endeavoured the stopping the bloud by Astringents, Bandages etc. But after all, I was put to the use of the actuall Cautery; which I did apply successfully." You might survive the battle, but the peace afterwards could be a real killer.

Camp life and training

In truth, thanks to poor supplies and little in the way of logistics, you were lucky if you got to the battlefield in the first place; the cramped conditions and lack of personal hygiene of the camps were a breeding ground for dysentery or cholera, scarlet fever, typhoid, plague, or diseases transmitted from person to person via lice (or even venereal diseases for the less-than-righteous soldier). Certainly, the name "camp fever" is synonymous with typhus, and arose from the affinity of the disease for these type of conditions. Life in an army camp during training was not easy.

Another problem, peculiar to the marshy, waterlogged fens and to lowland areas of Somerset, Kent and Essex, was that of malaria. Well-documented examples are difficult to come by, although frequent references to "ague" or recurrent fever are highly suggestive of malaria. Certainly Cromwell, himself a "fenman", showed evidence of having this infection for most of his life and it was probably the cause of his death. References to quartan fevers in the 17th and 18th centuries suggest that this was caused by P malariae. Thomas Sydenham (1624–89), a leading 17th century English physician, wrote in *Observationes Medicae* in 1676 that "anyone dwelling in the locality of marshes and lakes became impressed with a certain miasma which produces a quartan ague".

Another contributory factor would have been the uncertain nature of the daily diet and the vagaries of the weather. Accounts from soldiers in Holles' Regiment of Foot (a Parliamentarian regiment that was recruited predominantly from London apprentices serving in the butchering and dyeing trades) describe how in the summer months, for lack of other sustenance, the marching troops "drank stinking water", sometimes scooping it from the shallow indentations left by horse hooves! The soldiers were regularly soaked to the skin, and unable to dry their clothing adequately which would become filthy and often infested with lice – soldiers noted that when stripping the corpse of a Royalist drummer they found it to be "very lowsey". As a result of this, wounds frequently became infected, often with fatal consequences.

The privations endured during the winter months must have also produced a considerable number of cases of sickness, due to the extremes of cold, continual exposure to wet clothing and footwear, and the debilitating effects of an inadequate diet. Pneumonia and bronchitis must have been an ever-present hazard, while tuberculosis would have exacted an annual toll of deaths. The low resistance to infection engendered by the poor diet, incipient vitamin deficiencies – especially scurvy – and the climatic rigours to which troops were exposed compounded this problem.

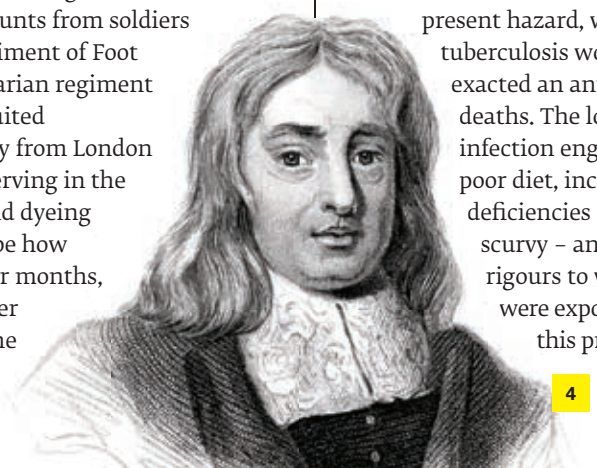
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Fig. 2. Richard Wiseman
Fig. 3. Cromwell on his horse at the battle of Marston Moor, 2 July 1644
Fig. 4. Thomas Sydenham

Besieged towns

Civilians also suffered the ravages of the conflicts. Royalists and Parliamentarians were constantly trying to impress men into their armies. Both sides took horses, food and other supplies for their armies. They forced people to provide free food and shelter to whichever troops turned up in their farm, village or town. In desperation, some areas formed their own militia to keep the Royalists and Parliamentarians away from their homes. There were severe outbreaks of plague in a number of towns and cities in England and Wales, especially during 1644 and, to a lesser extent, 1645.

Of course, plague had existed in England as an endemic disease for about 400 years, enlivened by periodic epidemics and occasional spectacular pandemic, the best known of which is the Great Plague of London in 1666. Outbreaks also occurred if the rat fleas (Xenopsylla cheopis) were transported in bales of woollen and other cloths from one town to another. This mode of transmission accounted for the characteristic sudden and sporadic outbreaks of plague in apparently unconnected locations. But generally, the largely open nature of the civil wars, with relatively few prolonged sieges, mitigated against plague as a major threat to troops who could, if they were aware of the presence of the disease in a town, avoid it.

Person-to-person infection with typhus, however, was a different matter entirely. The pattern and symptoms of the fever that decimated the Earl of Essex's Army at Reading in 1643, suggests typhus. Likewise, Sir William Waller's successful siege of Chichester in early 1644 was also followed by an outbreak of typhus amongst the garrison. Other serious outbreaks in 1644 occurred in several towns in the west country, particularly Tiverton in Devon, which was occupied for periods of time by Royalist and Parliamentarian armies in turn.

Other important "siege diseases" were smallpox and measles. The garrison of Basing House in Hampshire suffered from an outbreak of the former in 1644 at the height of the 19-week long siege. It should be remembered that the species of smallpox prevalent in England at this time was the milder European version known as alastrim (Variola minor), and not the more virulent Asiatic form which replaced it. Otherwise, the siege of Basing House would have ended abruptly with the death of most of the besieged. Similar outbreaks of a disease that disfigured rather than dealt death occurred in the Oxford garrisons during 1644, and no doubt among many other unrecorded towns and villages as well.

Conclusions

Death and incapacity due to illness, whether infectious or caused by diet and climatic conditions, may have played an important role in deciding some of the military outcomes of Civil War engagements. It clearly affected the fighting capacity of many soldiers, particularly unacclimatised town-dwellers, such as the London Trained Bands, who were quite unused to the rigours of the frequently unfriendly English climate.

It is estimated that England suffered a 3.7% loss of population and Scotland a loss of 6%, while Ireland suffered a loss of 41% of its population. This is in contrast to the 3% of the British population that died in the First World War.

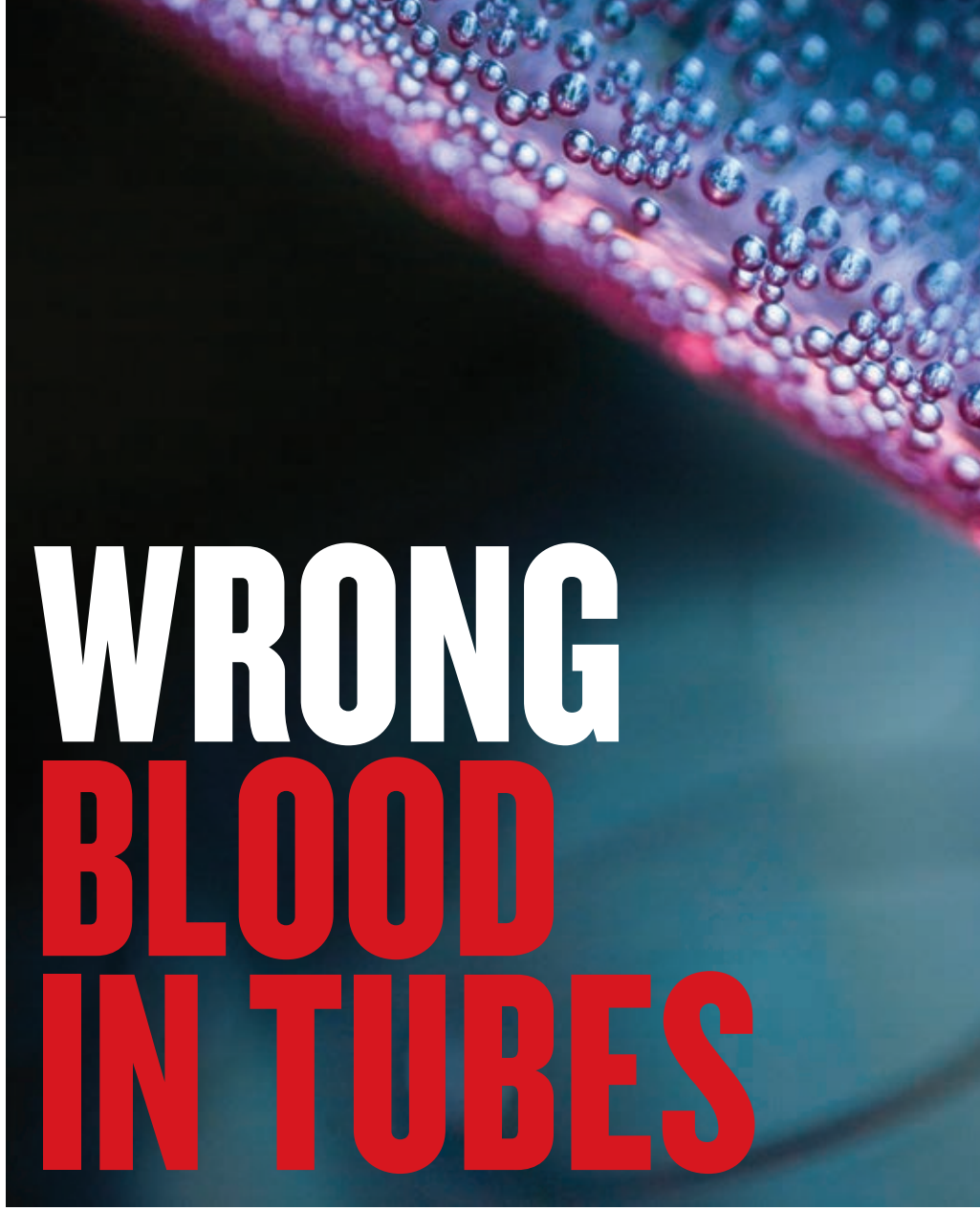
The impact on communities was devastating: homes were destroyed, the men needed for farming were gone and disease was rampant. Families were torn apart: brother against brother, son against father.

Moreover, there was the trial and execution of an anointed sovereign, and the presence of a standing army throughout the 1650s – the success of the New Model Army having demonstrated the benefits of a national standing army, rather than one with regional allegiances. After the restoration, Charles II created a standing army that was the forerunner of the modern British army. BMS

Stephen Mortlock is Pathology Manager at Nuffield Health, Guildford Hospital.

Thanks to poor supplies and little in the way of logistics, you were lucky if you got to the battlefield

IMAGES: WELLCOME-WIKI/ ALAMY/ISTOCK



WRONG BLOOD IN TUBES

Why does "wrong blood in tubes" happen and what can be done? **Rachel Moss** looks into the situation.

It's that sinking feeling in the middle of a busy shift in the transfusion laboratory when the analyser throws up that the group of the sample being processed does not match the historical group of the patient. That sinking feeling where you know somewhere, somehow, a patient has been compromised by this error – and it means someone, somewhere, is going to need to be re-bled. Wrong blood in tubes (WBITs).

It's that sinking feeling of knowing that you now have to sort it out, update the laboratory information system (LIMS), spend time trying to find the patient, find the person who made the error as well, ask for a repeat sample, photocopy the request form and the sample bottle, and contact the Transfusion Practitioner so it can be investigated. And it was all going so well...

So, why do WBITs happen? Have you ever asked yourself why they can't just bleed the right patient? Of course, to err is human, and a straw poll of clinical colleagues to ask why mistakes happen throws up a number of reasons familiar to many of us – competing priorities, system failures, human failures, external pressures, managing emergencies, new ways of doing things, changing environments. Reasons we have all considered when thinking about why something went wrong.

However, the cause of adverse events is multi-factorial and rooted in the fact that healthcare is a complex system of different people, with different priorities, using a number of different IT systems, working with a number of different skill sets, all with one focus – the patient.

Tales to tell

Ask any Transfusion Practitioner to list their latest WBITs and they will all have a few tales to tell. There is the FY1, Dr S, who after a 12-hour shift was still on the ward as Dr B, the night FY1, was in the emergency department (ED), trying to admit patients onto an already full acute medical ward. When asked to take admission bloods from the "new patient, bed 3, as Dr B is still in ED" Dr S took them to help his colleague and then went back to the computer to print off the request forms and label the samples.

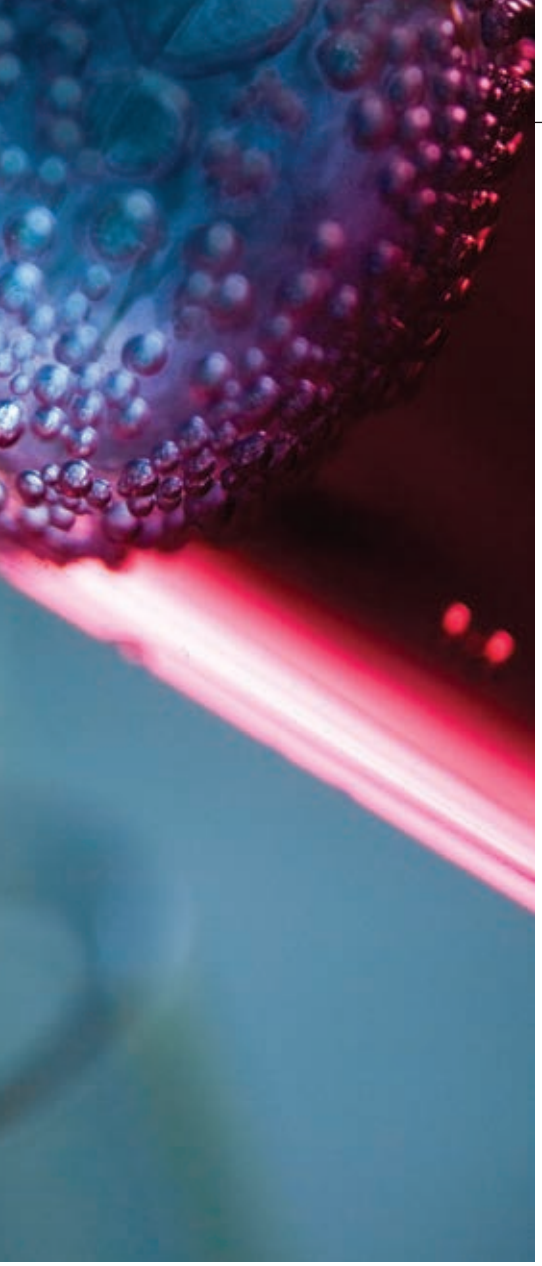
Or the Band 7 Nursing Sister who was admitting the day case cardiac angiogram list and, with the patients arriving before the Ward Clerk and not yet admitted on the system, thought she'd get ahead and take the admission bloods. But with no wristband or request forms available, they couldn't be correctly labelled.

Or the Surgical Registrar who had to take samples from an upset emergency patient whose first language was not English, and so just asked if they were called so-and-so, and as the patient nodded through her tears, took blood samples. All these resulted in a WBIT.

Clinical knowledge

So do our clinical colleagues know what to do? A recent piece of work undertaken at a London teaching hospital shows they do. They were asked a number of questions about WBITs and the answers in the main showed people do know.

One question, for example, asks for five statements to be rated in order of priority (1 being the most important, and 5 being the least important).



a) The patient must be comfortable before the blood sample is taken.
b) The patient must be positively identified before taking the blood sample.
c) The patient must understand the reason for the blood sample being taken.
d) The patient details on the request form must be correct.
e) The patient must be wearing a wristband.

I'm sure everyone would agree that "b" is the most important, as this is the critical part in the sample-taking process; 60% of respondents (doctors and nurses) thought so. But as a patient? Is it not more important you understand the reason for the sample being taken, and that you are comfortable? If you are managing this situation, would they not be the two most important things?

In another question, true-or-false statements were asked:
1) The blood sample bottle can be labelled away from the patient, so long as it is labelled from the request form and not the patient notes.
2) If the information written on the sample bottle matches the Cerner printed wristband, the information on the request form doesn't have to match up.
3) If a Cerner sample label is printed for blood transfusion samples, it must not be used and the sample must be handwritten.
4) If there is no wristband in place, the blood sample can still be taken, providing the patient can state their name and date of birth.
5) The sample bottle should be labelled after the blood sample has been taken from the patient, not before.

When these questions were posed to two different groups of biomedical scientists (mixed grades) as part of the London Regional Transfusion Committee BMS Empowerment days, they caused a great deal of discussion, with no consensus on some of the statements and questions.

"Human factors in healthcare" is now part of the management vocabulary and can be described as "enhancing clinical performance through an understanding of the effects of teamwork, tasks, equipment, workspace, culture, organisation on human behaviour and abilities, and application of that knowledge in clinical settings." In essence, addressing all those factors contributing to mistakes happening (competing priorities, system failures, and so on).

One way to look at human factors is by using a framework, such as the SHEEP model, which helps consider all the contributing factors:
- **Systems:** Culture, IT systems, information flow, organisation flow, improvement models
- **Human interaction:** team dynamics, conflict, leadership, behaviours of others, communication
- **Equipment:** equipment failures, lack of consumables, user issues, non-consumables (analysers, monitors)
- **Environment:** location, interruptions, physical, safety, ergonomics
- **Personal:** external influences, problems based on who you are, pathology, physiology, attitudes, behaviour, emotion.

Other considerations when reviewing the topic of WBITs include barriers to help prevent the error happening. This was clearly shown in the Swiss Cheese model, which illustrates the levels of defence, and considers active errors, latent conditions and the fact that when the holes line up, mistakes can happen.

Examples of barriers in sample taking may include the use of bedside PDAs to scan wristbands and print the sample label in real-time. Or the two-sample rule, which ensures the patient does not receive an incorrect ABO blood component based on the risk the first sample taken might be a WBIT.

There is no magic solution to prevent WBITs. If there was, every Transfusion Practitioner in the land would have adopted it. The well-worn path of up-to-date policies, comprehensive training and education, patient identification awareness campaigns (for staff and patients) and ongoing incident reporting, both locally and externally, to Serious Hazards of Transfusion (SHOT), remain our best weapons.

However, next time you get a WBIT in the laboratory, just remember that a long list of contributing factors may have led to it happening. Then start updating the LIMS, finding the patient, finding the person who made the error, asking for a repeat sample... BMS

Rachel Moss is a Transfusion Practitioner at Great Ormond Street Hospital for Children NHS Foundation Trust, London.

NEW BLOOD CELLS DISCOVERED

The first findings of the landmark Human Cell Atlas project have been reported and reveal a major discovery.

HUMAN CELL ATLAS

The Human Cell Atlas is the first project of its kind and has been called as ambitious in scope as the Human Genome Project. The atlas aims to chart the types and properties of all human cells, across all tissues and organs, to build a reference map of the healthy human body.

It comprises members from many scientific institutions around the world, who are working together in the hope of achieving the ambitious goals of this project.

By making the atlas freely available to scientists all over the world, it is hoped to transform our understanding of human development and the progression of diseases such as asthma, Alzheimer's disease and cancer.

In the future, the reference map could also point the way to new diagnostic tools and treatments.

humancellatlas.org

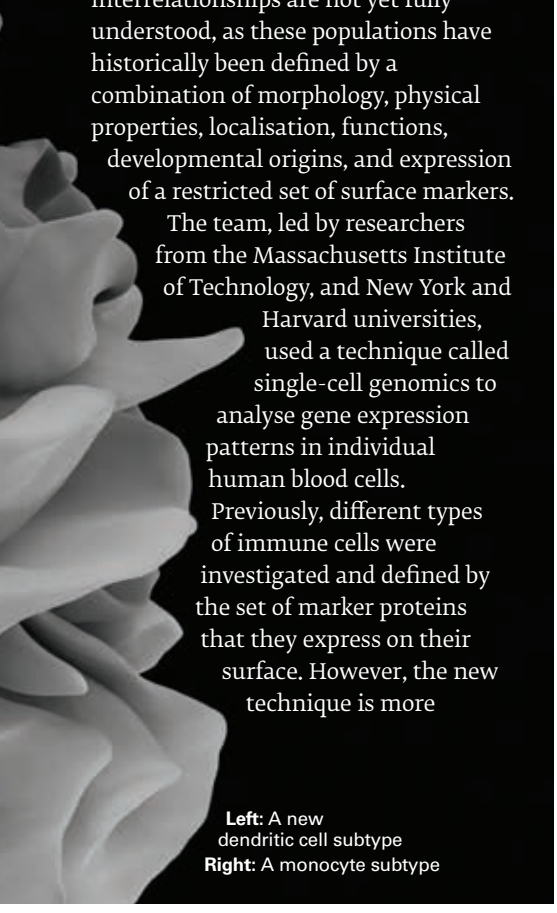
Scientists have found four new types of white blood cells in the human immune system. They have identified two new dendritic cell subtypes and two monocyte subtypes. They have also discovered a new dendritic cell progenitor.

Dendritic cells display molecules called antigens on their surfaces. These are recognised by T cells, which then mount an immune response. Monocytes are the largest type of white blood cell and can develop into macrophages that digest debris in our cells (see box, right, for more information).

It is known that these cells play a central role in pathogen sensing, phagocytosis, and antigen presentation. However, their identities and interrelationships are not yet fully understood, as these populations have historically been defined by a combination of morphology, physical properties, localisation, functions, developmental origins, and expression of a restricted set of surface markers.

The team, led by researchers from the Massachusetts Institute of Technology, and New York and Harvard universities, used a technique called single-cell genomics to analyse gene expression patterns in individual human blood cells.

Previously, different types of immune cells were investigated and defined by the set of marker proteins that they express on their surface. However, the new technique is more powerful and can reveal previously unrecognised and rare cell types that would be otherwise difficult to find.



Left: A new dendritic cell subtype
Right: A monocyte subtype

The researchers performed single-cell RNA sequencing of ~2,400 cells isolated from healthy blood donors and enriched for HLA-DR$^+$ lineage$^-$ cells. This profiling strategy and unbiased genomic classification was used with follow-up profiling, and functional and phenotypic characterisation of prospectively isolated subsets.

The research is funded by Wellcome and is one of the first major outputs from the Human Cell Atlas initiative – a project which aims to describe all the cell types in the human body, across all tissues and organs, to create an "atlas" of the healthy human body (see box, left, for more information). It is thought these first findings will offer a useful basis for conducting analysis on other cell types and tissues.

Divya Shah, from Wellcome, says: "In this study, scientists have used cutting-edge technologies to find that there are many more types of cell than we originally thought. The next step is to find out what each of these cell types do in our immune system, both when we're healthy and during disease."

The team has published a paper about their work in the journal *Science*. The abstract says: "Our revised taxonomy will enable more accurate functional and developmental analyses as well as immune monitoring in health and disease." They say their breakthrough "presents a new therapeutic target readily accessible in the bloodstream for manipulation, as well as a new source for better in vitro dendritic cell generation".

They conclude: "Although the current results focus on dendritic cells and monocytes, a similar strategy can be applied to build a comprehensive human immune cell atlas." BMS

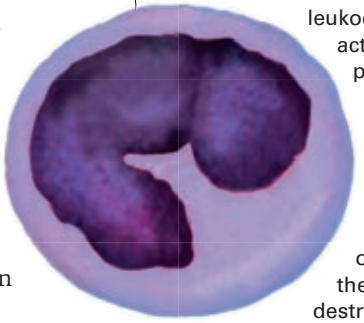
The next step is to find out what each of these cell types do in our immune system

WHAT ARE DENDRITIC CELLS?

A type of antigen-presenting cell that performs an important role in the adaptive immune system. Their main function is to present antigens. In addition, dendritic cells have the capacity to induce a primary immune response in the inactive or resting naïve T lymphocytes. In order to do this, they capture the antigens from invading bodies, which they process and then present on their cell surface, along with the necessary accessory or co-stimulation molecules.

WHAT ARE MONOCYTES?

The largest cells of the blood, which make up about 7% of the leukocytes. Monocytes are actively motile and phagocytic, and capable of ingesting infectious agents as well as red cells and other large particles, but they cannot replace the function of the neutrophils in the removal and destruction of bacteria.



ZIKA VIRUS IN FOCUS

Brazil has just announced that the Zika virus is no longer a public health emergency. We look back at the outbreak and forward to the attempts to create a vaccine.

Eighteen months ago the outbreak of the Zika virus made headlines around the world. It had not been considered a major health threat until the realisation that it could lead to severe birth defects, particularly the congenital condition microcephaly.

Pictures of babies suffering from the condition caused panic to spread, as the virus advanced and cases were reported in dozens of countries. Trips were cancelled to those places hit hardest by the virus, especially Brazil, which was at the centre of the outbreak and was gearing up for the 2016 Olympics.

The country declared a "national emergency" in November 2015, following which the World Health Organisation (WHO) classed the Zika virus as an international medical emergency.

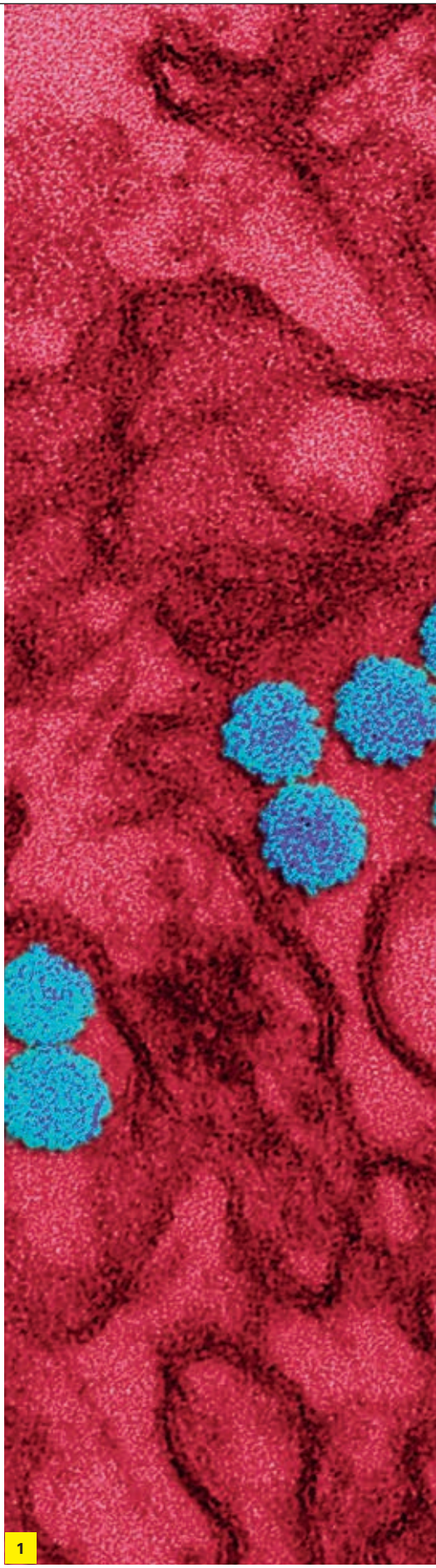
End to the emergency

The infection has since been linked to severe birth defects in almost 30 countries, with more than 2,100 cases of nervous-system malformations reported in Brazil alone.

However, in May this year Brazil announced an end to the public health emergency. The news came as figures showed that in January to mid-April this year, 95% fewer cases were recorded than during the same period last year. The incidence of microcephaly fell too.

The WHO has also changed Zika's status, but is still classing it as a "significant and enduring threat". David Heymann, Chairman of the Zika virus Emergency Committee, says: "We are not downgrading the importance of Zika. By placing this as a long-term programme of work, we are saying Zika is here to stay."

Dr Peter Salama, WHO Director of Emergencies, believes that the imminent threat may not be as severe, but that we are entering a new phase of fighting the virus, "which is a long-term problem that the world will have to deal with for many years to come [...] Zika is here to stay and the WHO's response is robust."



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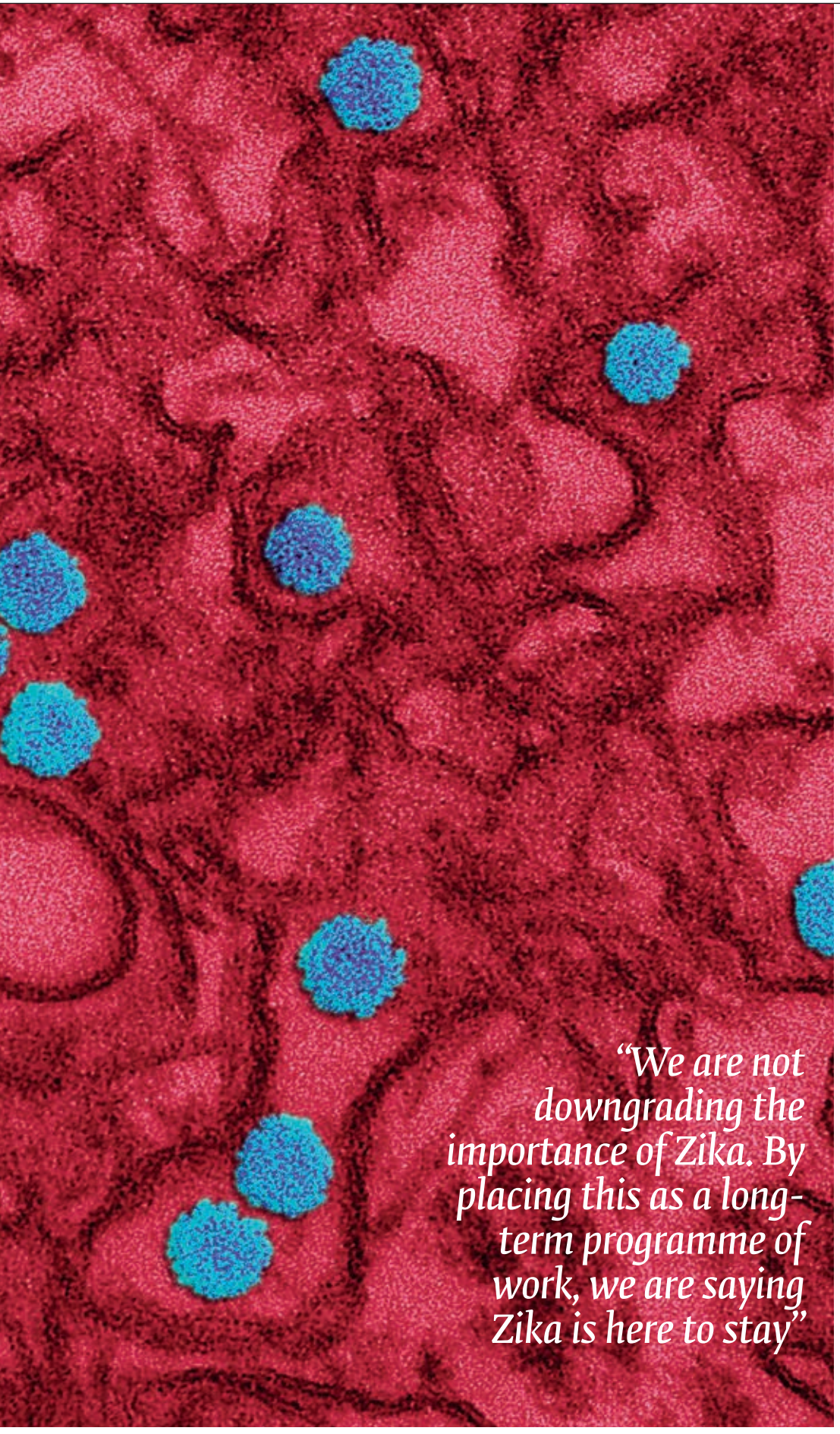


"We are not downgrading the importance of Zika. By placing this as a long-term programme of work, we are saying Zika is here to stay"

Fig. 1. Coloured transmission electron micrograph of Zika virus particles (blue)

THE HISTORY OF THE ZIKA VIRUS

1947 Scientists identify a new virus in a rhesus monkey in the Zika forest of Uganda.

1952 The first human cases of Zika are detected in Uganda and the United Republic of Tanzania.

1964 A researcher in Uganda is infected with Zika while working on the virus, confirming that it causes human disease. He reports the illness as "mild".

1969 Zika virus is detected in mosquitoes in equatorial Asia.

2007 The first large Zika outbreak in humans happens on the Pacific island of Yap, with an estimated 73% of residents infected.

2013 Outbreaks occur in other Pacific islands: French Polynesia, Easter Island, the Cook Islands, and New Caledonia.

2015 In May, Brazil's National Reference Laboratory confirms Zika virus is circulating in the country.

October: Brazil reports an unusual increase in the cases of microcephaly in newborns.

November: National public health emergency declared as cases of suspected microcephaly increase.

2016 First diagnoses of intrauterine transmission of the Zika virus in two pregnant women in Brazil.

Fig. 2. Baby with the congenital condition microcephaly
Fig. 3. Zika virus molecular model

Three potential vaccines

Despite the good news for Brazil, the global threat still looms large, and the drive to create a vaccine against Zika continues apace. While it will be years before they are available to the public, three potential vaccines are being tested in humans at present. Two are based on cutting-edge DNA vaccine technology, and the third is based on the more standard inactivated virus model.

The DNA vaccines under development interfere with the virus' ability to enter cells and replicate itself, while the inactivated vaccine aims to create an immune response that would provide future protection against Zika.

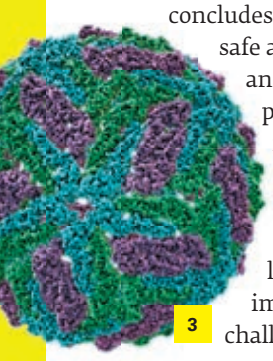
Of the three, a DNA vaccine developed by the US National Institutes of Health has progressed the furthest to date, with a large multi-site phase 2 trial underway involving almost 2,500 test subjects.

Stephen Thomas is a Professor of Infectious Disease at the State University of New York Upstate Medical University in Syracuse. He is also one of the authors of a paper published in the journal *Immunity*, which reviews how the three vaccines are progressing.

He states that the pace of research and development has been "incredibly brisk" and that "some groundbreaking strides have been made in very short periods of time."

But he stresses that "it is a very large chasm between animal data and what translates into a safe and efficacious vaccine for humans".

The paper also reinforces this. It concludes: "The development of a safe and effective vaccine is an urgent global health priority. Promising data from preclinical vaccine studies in mice and monkeys suggest that an effective vaccine will likely be possible, but important scientific challenges remain." BMS



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IMAGES: SCIENCE PHOTO LIBRARY/ISTOCK/REUTERS

THE ZIKA VIRUS IN NUMBERS

80%
The estimated amount of people infected with Zika who will never know they have it

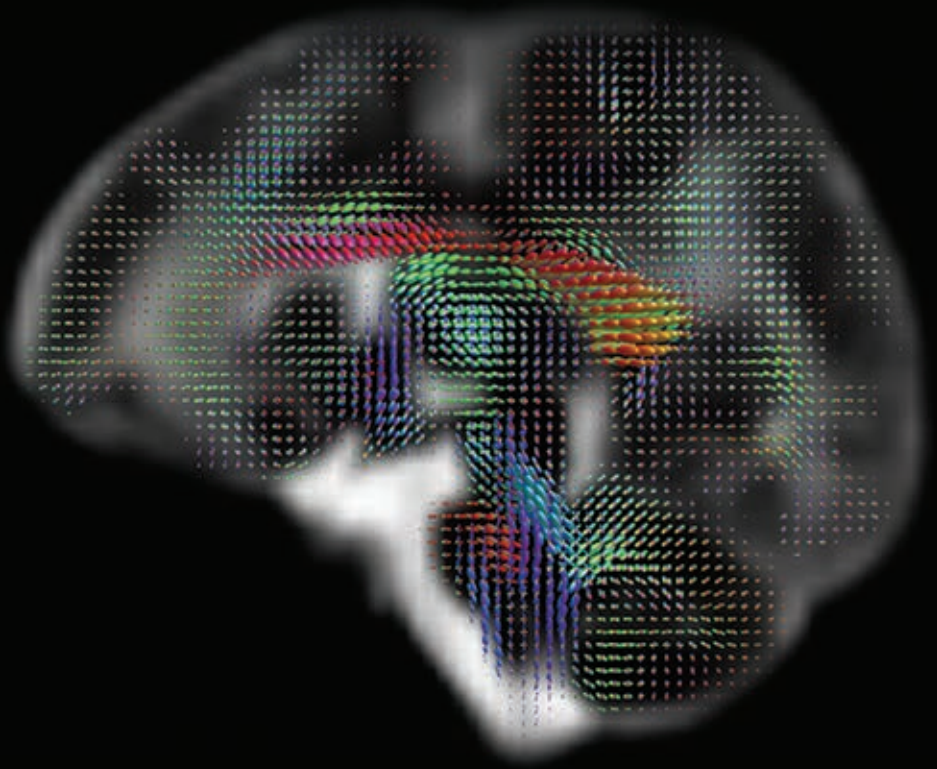
5,238
Number of cases of Zika virus in the continental US and Hawaii since the outbreak began

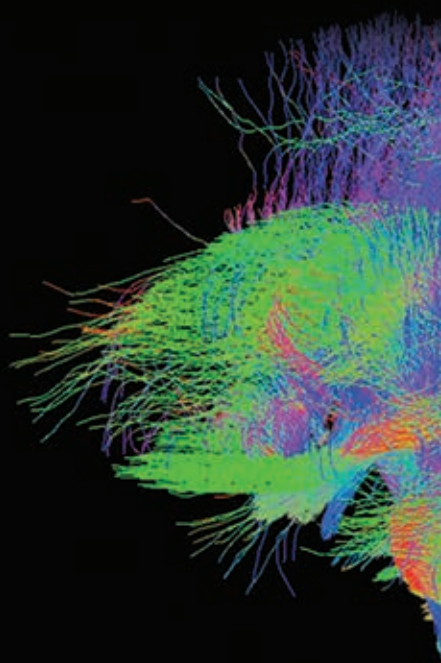
84
Number of countries and territories reporting mosquito-borne Zika virus transmission, as of March 2017

3,530
Total cases of micro-cephaly in Brazilian new-borns in 2015

1.4bn
Number of people in Asia living in areas suitable for Zika virus transmission

95%
The drop in Zika cases reported in Brazil this year, compared to last year





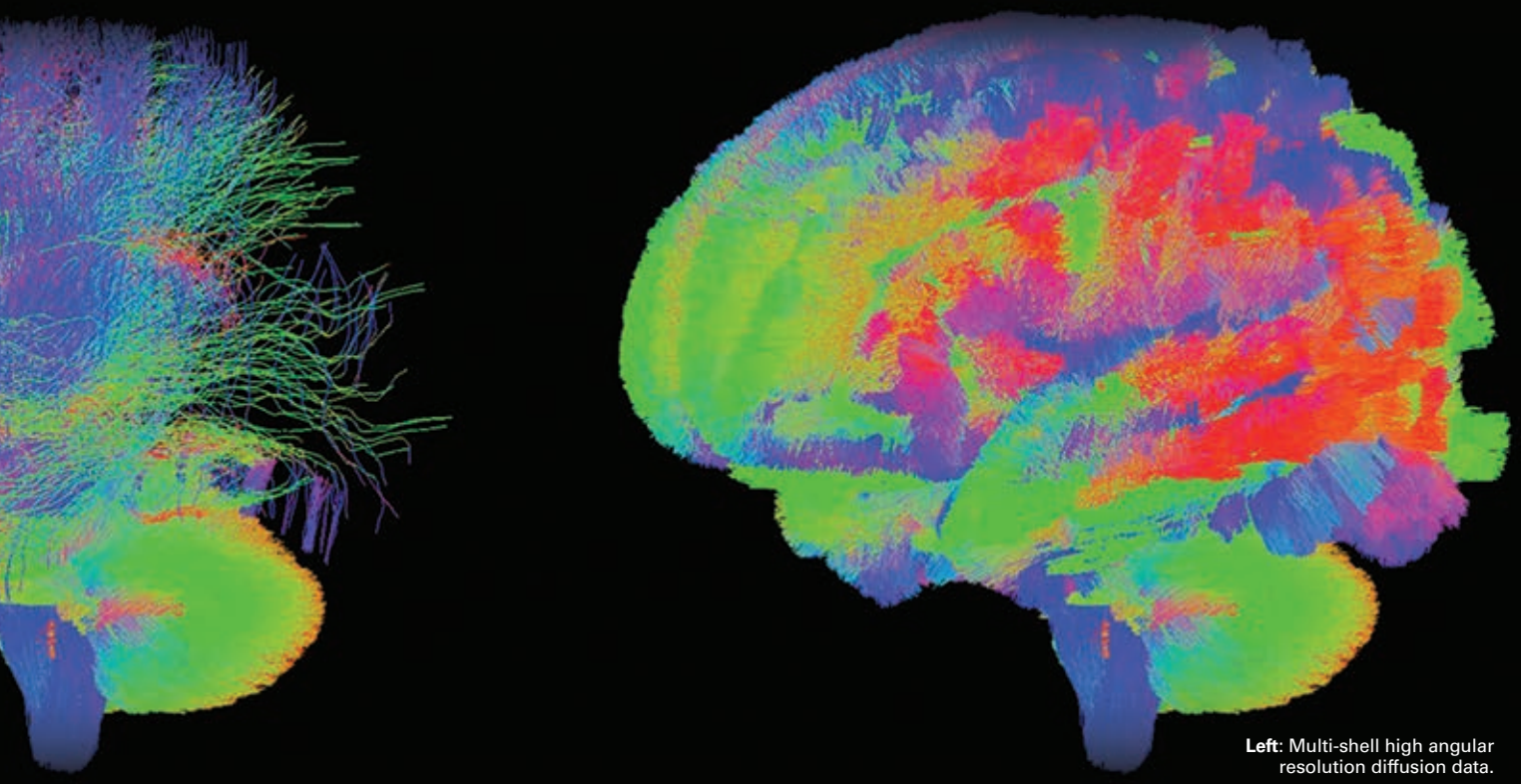
MAPPING BABY BRAINS

A look at the stunning first output from a project to understand a range of conditions by building the biggest collection of baby brain development images ever gathered.

Thousands of images have been released as part of a groundbreaking project to understand the development of the brain. The Developing Human Connectome Project (dHCP) looks at the wiring and function of the brain during pregnancy and how this changes after birth. It is hoped to lead to a better understanding of how conditions, including cerebral palsy and attention deficit disorders, develop within a baby's brain.

These first images come from 40 newborn babies who underwent magnetic resonance imaging (MRI) scans in their sleep, with the aim of capturing high-resolution images of early brain anatomy and neural wiring. The images and all data from the project are free for scientists from around the world to download and use in their own research.

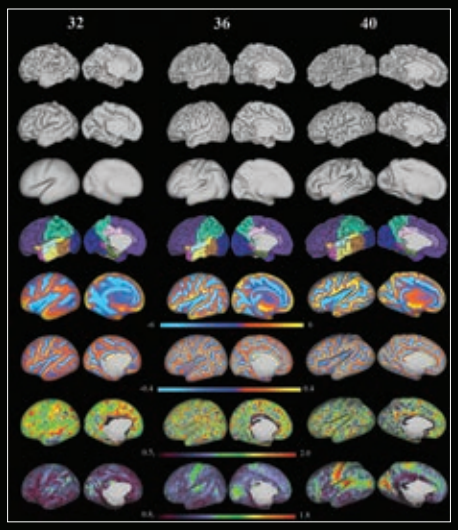
The dHCP project had to develop new MRI techniques that allow scans of the brains of babies to be acquired. Previously, problems were caused by the babies' movements and small size, as well as the difficulties of keeping vulnerable infants safe inside the scanner.



Left: Multi-shell high angular resolution diffusion data.
Middle and right: Visualisation of anatomical connections in the developing brain.

When the project began in 2013, scans regularly failed as the babies would wake up in the middle of the procedure, which can last up to three hours. However, the babies are now fed and prepared for their scans at their mother's side before being carried to the scanner. To reduce the risk of the babies waking, the scanner software has also been tweaked to stop it making any sudden noises.

The research consortium is funded by a €15m grant from the European Research Council, and one of the goals of the project is to make sure that the data is shared as widely as possible. The preliminary images, which were released in May, will be followed by further releases until a vast dataset, together with genetic and other information, is available. When finished, the researchers say this will be the biggest and best-quality collection of baby brain development images ever gathered.



Lead investigator Professor David Edwards from King's College London says: "Having lots of data will mean that we can study what is normal and abnormal in terms of brain development. We can start to answer important questions, like what happens to the brain when babies are born prematurely, or how does the brain develop differently in children with autism?"

The project is ongoing, and as well as studying more babies, the team, based at St Thomas' Hospital in London, is now recruiting pregnant mothers for fetal scanning. The work is being driven by collaboration between King's College London, Imperial College London and the University of Oxford. The final goal is to create a dynamic map of human brain connectivity from 20 to 44 weeks post-conceptional age, which will link together imaging, clinical, behavioural, and genetic information. BMS

For more information on the project, and to access all the images and data, visit **developingconnectome.org**

HOW TO... ...NETWORK SUCCESSFULLY

With the IBMS Congress 2017 coming up, author and networking expert **Stefan Thomas** explains how to make the most of the four-day event.

Your parents, if they follow the same rules as 99% of parents on the planet, spent your formative years telling you, among other sage advice, not to talk to strangers. It was good advice. You kept clear of strangers on that basis for as long as you could. You gave them a wide berth. Instead, you stuck around friends and people you definitely had something in common with.

Life was good. Strangers were bad. This all made sense. You liked it that way.

University was simple – no strangers there, after you got to know them.

Your first couple of jobs were great too. You kept up a simple profile on LinkedIn and still, 20 years after you were first advised by your parents, were managing to stick to their advice, even though you had disregarded the other stuff about not drinking too much and getting a proper job.

And then, a few years into your career, you are packed off to a conference or seminar or expo and, just as you head for the train station are told "and make sure you network, its what these events are really for".

Horror. Instead of keeping your head down, listening to the presentations, taking advantage of the free lunch and then heading home, you're told you have to utterly disregard everything you've believed since childhood and spend your time talking to a bunch of strangers. Not only that, but you're meant to do so with some purpose.

Networking doesn't need to be as scary as you might think it is. In fact, I believe we overthink it, and an awful lot of the advice we've been given about networking over the years is over-engineered. Here are a few tips, which I really hope will make it as pain-free as possible.

01 Set the bar very low.

Too many people put themselves under pressure by aiming to achieve far too much at every networking opportunity. Any networking event is just the start of the conversation, and starting conversations doesn't have to be difficult. Remember that you already have loads in common with everyone else at the event. You are, for a start, at the same event. You may be listening to the same speaker. You may be wondering where and when the lunch is. Instead of seeking out some clever opening phrase designed to impress the person you're speaking to, just aim to start the conversation and then let it flow. You are simply aiming to make new contacts with whom you can keep the conversation going after the event. Which cleverly leads to...

02 Remember that the first meeting is the start of the conversation.

It is now your job to keep the conversation going. People often feel the need to sell themselves at every opportunity, but I prefer to follow the advice given by Dale Carnegie in his book, *How to Win Friends and Influence People*. Carnegie says: "You will win more friends in two months by being interested in them than you will in two years by trying to be interesting to them." Before you send a follow-up message, check out if the other person has written any white papers, or published any articles. When you connect with them, whether on LinkedIn or via email, make reference to their stuff. Give them feedback or honest compliments. You are significantly more likely to get a positive response from someone if you have put in the effort to get to know them a little, rather than just blindly selling yourself to them.

03 Let your profile do the talking.

People like to reciprocate. If you've spent the time and effort getting to know them, a significant proportion will return the favour. So make sure your own LinkedIn profile is up to date, with a photo so that they can remember you, as

well as some words to describe you and your work and, crucially, links to anything you have published, details of the work you have done, and any awards or accolades you have won along the way. Ensure that you keep this up to date with any new information and share any new publications or articles too. As you pop up in your contacts' timelines, this will gently remind them that you exist and the sort of work you do.

04 Play the long game.

One of my closest friends and contacts uses the expression "making friends for the sake of making friends". We are both in business and it is entirely refreshing when someone puts time into a relationship without an agenda. Instead of going straight for the kill, and asking for the opportunity or interview, be the one who stands out by relaxing into each new relationship and letting your expertise and experience sell you over time. People, almost universally, do not like being sold to. Keep in touch and allow yourself to be in the right place at the right time when an opportunity arises.

05 And finally, remember that plenty of people are as unsure about networking as you are.

This isn't an exact science, nor does it have hard and fast rules. Even in business, networking is often seen as a necessary evil rather than something people enjoy from the outset. But building a network over time can be the most rewarding, supportive and empowering activity. Having a group of people you have put the effort into building strong relationships with, who are at the end of a phone or email when you need their advice or counsel can help massively in any career. I am fortunate in that I now have people from all walks of life who I know will answer the phone when I call. The payback from my network, in terms of my career, business and personal development has far exceeded the effort I have put into building that network.

Your parents were right, and their advice was sound. But in the words of WB Yeats: "There are no strangers here; only friends you haven't yet met." BMS

Stefan Thomas is the author of *Business Networking for Dummies* and *Instant Networking,* both published by Wiley. He welcomes connections on LinkedIn at **linkedin.com/in/noredbraces**

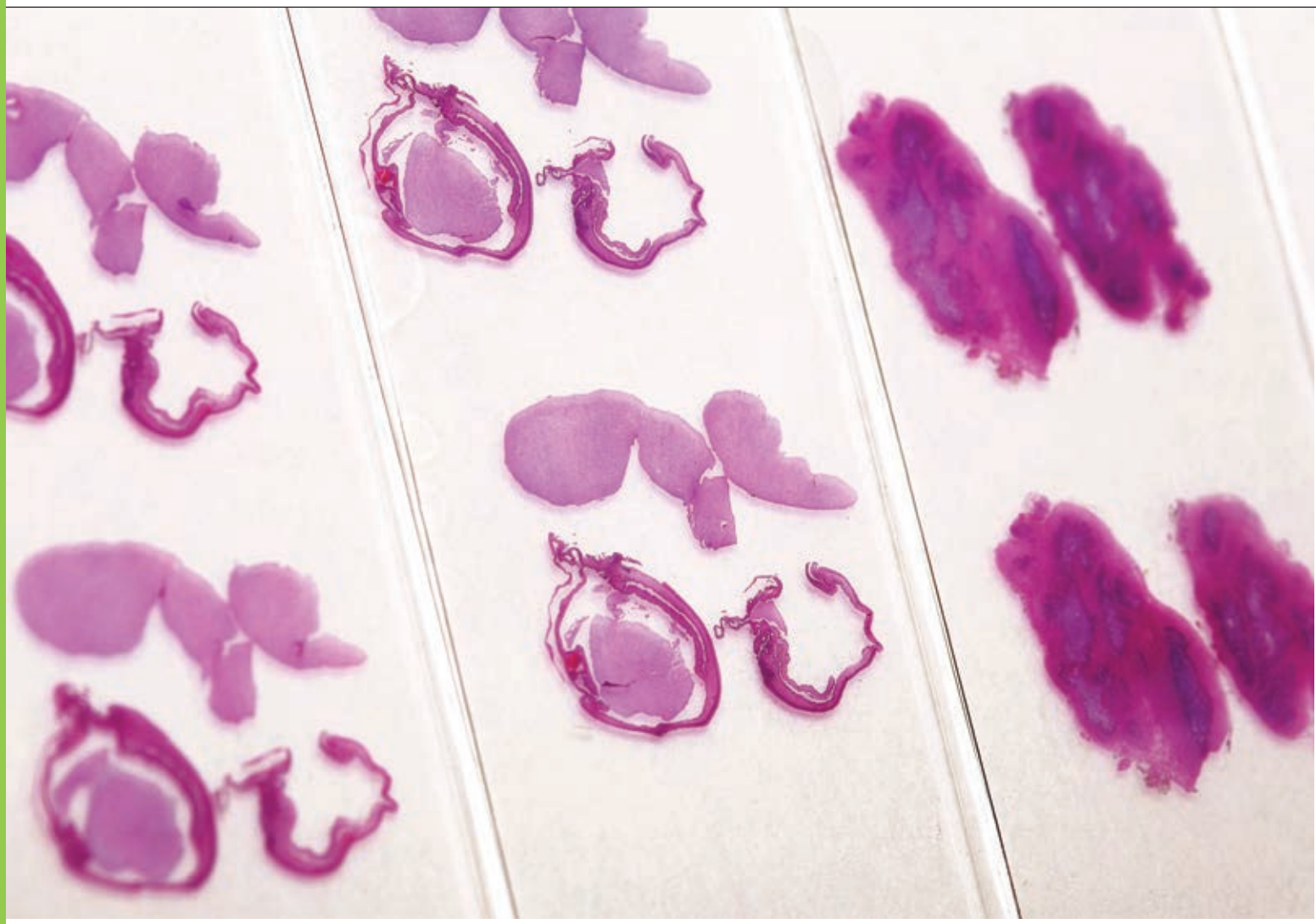
CONGRESS IN NUMBERS

300 Speakers

4 Days

170+ Exhibitors

40 Microscopy stations



BREAKING NEW GROUND

HISTOPATHOLOGY REPORTING TRAINING SURVEY

Brian Nation analyses the figures and draws out the trends from a survey of biomedical scientists on histopathology reporting training.

The involvement of biomedical scientists in histological dissection has a chequered and erratic history over more than half a century. But acceptance that they have an important role to play alongside histopathologist colleagues has developed steadily over the past decade.

First, joint recognition by The Royal College of Pathologists (RCPath) and the IBMS that appropriately trained and qualified biomedical scientists could dissect a range of histological material, including breast, lower gastrointestinal and gynaecological specimens, led to the introduction of the Diploma of Expert Practice and relevant Advanced Specialist Diploma examinations, and to an increasing number of biomedical scientists operating at an advanced practitioner level in histological dissection.

Subsequently, in 2010 – following discussions between the Department of Health, RCPath and the IBMS – the focus moved to histopathology reporting and the start of the Biomedical Scientist Histopathology Reporting Pilot Project, with participants in cellular pathology departments signing up in England, Scotland and Northern Ireland.

The initial focus was on gastrointestinal and gynaecological pathology, chosen as they represent areas of practice with a high volume of low-complexity, low-litigation reporting, and which frequently contribute to departmental reporting backlogs. From September the qualification will expand to offer a dermatopathology option.

Histopathology reporting training comprises four stages (A–D), with successful completion of stage D required for a biomedical scientist to commence autonomous reporting of either gastrointestinal or gynaecological specimens – because of the time commitment, candidates cannot train in both specialisms in parallel.

With an increasing number of practitioners completing stage C, and in one case stage D, it was felt to be an appropriate time to initiate a survey of the biomedical scientists undertaking, or having almost completed, the programme and also those who had withdrawn from the programme prior to completion. A total of 32 individuals on the programme responded.

Experience prior to commencement of training

In terms of prior experience, the questionnaire offered four possible role choices (Advanced Practitioner in Histological Dissection, Advanced Biomedical Scientist in Cytopathology, Histopathology Manager, Cytopathology Manager). Just under a third (31.3%) of respondents held either the IBMS/RCPath Diploma of Expert Practice in Histological Dissection or the IBMS Advanced Specialist Diploma in Cervical Cytology or in Non-Gynaecological Cytology. But 11 (34.4%) responders gave alternative role titles.

In total, 11 of the 32 gave a range of examples of practice when asked about previous histopathology reporting experience. This clearly illustrated an uncoordinated, ad hoc approach to any form of biomedical scientist involvement in histopathology reporting.

Allocation, management and supervision of training time

The questionnaire also sought to clarify the demands put upon biomedical scientist trainees, and to obtain their views on the structure of the programme and the support received. The allocation of protected time for training prompted a considerable response, with, for example, the need to defer stage B for a year, undertaking the necessary work after hours and at weekends, and allocation of 100% protected time demonstrating that there is neither a coordinated approach to, nor appropriate guidance in, implementing the programme.

Although the majority of responders (25 out of 32) thought the breadth of the training programme was "about right", this subject provoked considerable comment, and perhaps reflects the lack of exposure to previous broad medical education and training.

Supervision was reported to be good or above during stages A and B, but this reduced to just over 50% during stage C, and just over 40% in stage D. The perceived reduction of supervision during stages C and D may be a reflection of increasing confidence in a trainee's ability and growing expertise; however, one responder reported no supervision during stage C. With regard to supervision provided by other clinical staff, lack of support was an increasing feature as training progressed through the stages, with 12.5% of respondents reporting "none" during stage A, up to 33.3% during stage D.

The majority thought the breadth of the training programme was "about right"

Towards an independent reporting role

On completion of stage C, 75% of respondents reported that they had commenced independent reporting. Seven (25%) said they were guaranteed a reporting role on completion of stage D, five (18%) had received no guarantee, while 16 (57%) were unsure of their position.

In terms of Agenda for Change pay band expectations, three anticipated Band 8c, and 15 were unsure. Twelve of the respondents made comment, with both Bands 8b and 8c being mentioned.

One said: "If I didn't think my department would allow me to independently report once qualified, I would give up now." BMS

Brian Nation is an Editor and Author specialising in biomedical science.

MY IBMS NEWS

OBITUARY

DENNIS BERTRAM SLADE 1928-2017

Dennis Slade, a former President of the Institute, was a man whose influence on the development of biomedical science covered the domestic and international arenas, as well as the professional and trades union fields.

He was born and brought up in North Curry in Somerset. As a young man he was involved with the St John Ambulance brigade and played trombone and drums in a local dance band and brass band. During his national service, he was put into the pathology lab because of his association with St John Ambulance. He then secured a post in Musgrove Park Hospital in Taunton and, after a period as a single-handed technician in Bridgwater, returned to Taunton, eventually becoming Chief Technician in haematology. Dennis became involved with the Trades Union, the Hospital League of Friends, was President of the local Trades Council and became a Justice of the Peace. In 1974, he moved to Bath as Principal Medical Laboratory Scientific Officer at The Royal United Hospital, a post he held until his retirement.

His interest in the profession developed into serving on a national committee of the union and election to the Institute's Council, where he quickly established himself as a conscientious Council Member with a quick grasp of the issues and an eye for detail. Respect for him on Council was such that he went on to be elected President and served in this capacity from 1979 to 1981. He represented the Institute on the Standing Representative Committee for Medical Laboratory Technology at the EEC and was elected as a Council Member of the International Association of Medical Laboratory Technology, eventually becoming its President. His influence was felt in all aspects of the Institute's work, particularly education, where he served nationally on BTEC and CNAA, and worked with universities and colleges on the validation of courses. This was recognised by the conferment of an honorary MSc by Bristol Polytechnic.

The Institute owes a debt of gratitude to Dennis for his unstinting work over the years and our thoughts go out to his wife Gwyn and their three sons. Our thanks for their support for Dennis, which allowed him to make a major contribution to the work of the profession.

ACHIEVEMENTS

IBMS MEMBERS REPORT

The IBMS has published its annual *Members Report*, which is online and available now to download.

It celebrates the achievement of the IBMS and its members in the last year.

The report covers the topics: supporting members; professional development; advancement of biomedical science; advocacy; and organisational robustness.

It also celebrates IBMS members who have been awarded grants, honours and prizes, and outlines future IBMS plans.

→**To read the report, visit ibms.org/about/members-report**

IMAGES: ISTOCK

BIOMEDICAL SOCIETY TALK

Point-of-care testing and clinical placements

The Biomedical Science Society at University College Cork (UCC) held talks on point-of-care testing (POCT) and clinical placements.

The IBMS-affiliated UCC Biomedical Science Society arranged for speakers Bernadette Jackson and Stephen Power to discuss the issues.

Bernadette spoke on POCT, its increasing prevalence and potential benefits, alongside the pitfalls of the new technology.

Stephen spoke about his experiences of clinical placements and what the students could expect.

The UCC Biomedical Science Society is one of 22 IBMS student affiliate societies.

→**For more information, visit bit.ly/IBMS_affiliates**

NOTICE OF MEETING

ANNUAL GENERAL MEETING 2017

The seventy-fifth annual general meeting of the Institute of Biomedical Science will be held at Robert Gordon University, Garthdee Campus, Garthdee Road, Aberdeen, AB10 7QB on Saturday 3 June 2017 at 11.30 am. Official notification of the meeting was published in the May issue of *The Biomedical Scientist* (page 41) and was also featured on the IBMS website.

JOURNAL-BASED LEARNING EXERCISES

Each article's contents should be read, researched and understood, and you should then come to a decision on each question. The pass mark is 17 out of 20 questions answered correctly. JBL exercises may be completed at any time until the published deadline date. Please select your choice of correct answers and complete the exercises online at: **ibms.org/go/practice-development/cpd/jbl**

DEADLINE WEDNESDAY 6 SEPTEMBER 2017

	Strategies to control hepatitis B: public policy, epidemiology, vaccine and drugs. Locarnini S, Hatzakis A, Chen DS, Lok A. *J Hepatol* 2015; **62** (1 Suppl): S76–86. Assessment No: 060617		**Healthcare Science Apprenticeships**. www.nshcs.hee.nhs.uk/news/item/361-new-healthcare-science-apprenticeship-programme *and within it* www.gov.uk/government/uploads/system/uploads/attachment_data/file/586614/Apprenticeship_Standard_L6_Healthcare_Science_Practitioner.pdf. Assessment No: 060917
01	There is approximately 70% chance that an infant born to a mother with hepatitis B virus (HBV) infection and a serum hepatitis B surface antigen (HBsAg) viral load of over 9 $\log_{10}$ copies per mL will not be infected with this virus perinatally.	01	Employers should work with higher education providers to implement HCS apprenticeships as of September 2017.
02	Complete elimination of HBV from infected individuals through antiviral chemotherapy is possible using currently available treatments.	02	The HCS apprenticeships available are level 2, 4 and 6.
03	The policy of universal infant vaccination against HBV has been implemented in over 90% of WHO member states, and this includes all developed countries.	03	Assessment for any standard is via an end-point assessment.
04	The Risk Evaluation of Viral Load Elevation and Associated Liver Disease (REVEAL-HBV) study showed that chronic HBV carriers with low HBV DNA viral loads were about twice as likely to develop cirrhosis as people who did not have HBV infection.	04	The Healthcare Science Practitioner (HCSP) standard expects the apprentice to be able to apply leadership capabilities.
05	Data from Taiwan have indicated that the incidence of hepatocellular carcinoma in patients who are HBsAg-positive, hepatitis B 'e' (HBe) antigen-negative is less than a third of that among patients who are HBe antigen-positive.	05	The HCSP standard does not mention HCPC standards of ethics.
06	After 30 years of universal childhood vaccination in Taiwan, rates of HBsAg positivity within the vaccinated populations have decreased by over 90%.	06	The standard expects students to develop skills in audit and quality improvement.
07	HBV viral load is the only factor considered in the decision of whether to start a patient with chronic HBV infection on a course of antiviral chemotherapy.	07	The standard is specifically designed for the life sciences only.
08	The reported prevalence of HBV infection in adults is less than 5% in Russia.	08	It is anticipated the level 6 apprenticeship will take three years to complete.
09	Anti-HBV nucleoside/nucleotide analogues are effective in reducing HBV viral activity, but they cannot be considered as therapy to alleviate existing liver damage such as fibrosis.	09	All HCS end-point assessments are written and available.
10	HBV was discovered serendipitously by Blumberg and colleagues, who were working on immunological interactions between unrelated patients, and the finding was reported in 1965.	10	Teaching of health and safety and risk assessment are outside the scope of the standard.
11	According to data published in 2010, the estimated number of deaths per annum from HBV infection is less than half the number from HIV infection.	11	The standard covers CPD and undertaking appraisals.
12	Evidence suggests that the number of people affected by chronic viral hepatitis around the world has been consistently overestimated, and most people have a good understanding of the disease.	12	Taking personal accountability and responsibility for one's own practice is explicitly noted.
13	HBV isolates classified in genotype F have not so far been found in Europe.	13	There are no numeracy or linguistic criteria required to enter an apprenticeship.
14	The 'immune reactive' phase of chronic HBV infection is characterised by high HBV DNA viral load and normal liver function tests.	14	It is down to employers how they go about taking on apprentices.
15	Patients who are HBsAg-positive, anti-HBe antigen-positive, with a low serum viral load and an HBV virus in genotypes C or D have been consistently found to respond best to pegylated interferon therapy.	15	An outcome of the level 6 apprenticeship will be to be able to write Standard Operating Procedures.
16	More than 10% of individuals who acquire HBV as adults develop chronic infection.	16	The standard does not require apprentices to be able to demonstrate skills in presentation to others.
17	HBV DNA becomes integrated into the host hepatocyte genome, and this is how viable virus particles continue to be produced.	17	Level 6 apprentices are expected to be able to demonstrate skills of critical thinking.
18	Renal disease can be a complication of HBV infection itself and some antiviral chemotherapeutic agents used to treat it.	18	The standard does not anticipate that apprentices will have to be able to write grant applications.
19	The estimated prevalence of chronic HBV in 2005 was greater than that calculated for 1990.	19	The apprenticeship route ends with eligibility to register with the Academy for HCS-accredited register only.
20	Studies suggest that most patients treated with nucleotide or nucleoside inhibitors for prolonged periods do not clear HBV permanently.	20	The standard requires apprentices to develop skills in training and supervision.

REFLECTIVE LEARNING

01	Critically discuss the United Kingdom's policy on hepatitis B vaccination in light of evidence from other countries' programmes.	01	How do you perceive the level 6 apprenticeship pathway to differ from the current route to qualification for biomedical scientists in terms of the skills and abilities the apprentice should possess at the end of the programme?
02	Discuss how hepatitis B virus escape mutants may affect vaccine efficacy and the specificity of standard tests intended to detect the virus in patients' serum samples.	02	What do you think the impact of apprenticeships will be on the future development of the workforce in biomedical sciences, and will this be beneficial or detrimental?

EVENTS AND TRAINING COURSES

A wide range of training courses, CPD and local events and activities is listed below. Members are advised to contact organisers for further information. A full list is available on the IBMS website.

DATE	TITLE	VENUE CONTACT
June		
1 Jun	**HPLC/UHPL troubleshooting**	Edinburgh I jsumner@hichrom.com
6 – 8 Jun	**BMS/cytoscreener update course 4**	London I nwlh-tr.lrctcbooking@nhs.net
6 – 8 Jun	**Biomedical engineering: problem solving using clinical and biomedical application**	Wakefield I kathryn.hawke@nhs.net
13 Jun	**Method development strategies to exploit selectivity**	Birmingham I jsumner@hichrom.com
13 Jun	**Step-by-step hilic method development**	Birmingham I jsumner@hichrom.com
14 Jun	**UK NEQAS cellular pathology technique muscle/neuropathology and electron microscopy introduction workshop**	Liverpool I chantel.hodgson@ghnt.nhs.uk
17 Jun – 8 Jul	**Blood sciences short course (2017)**	London I c.ferrier@westminster.ac.uk
15 – 16 Jun	**Practical and clinical microbiology of anaerobes**	Cardiff I deborah_robinson@dwscientific.co.uk I 01274 595728
22 Jun	**UK NEQAS cellular pathology technique specialist workshop A**	Newcastle I chantel.hodgson@ghnt.nhs.uk
24 – 25 Jun	**Essentials in microscopy**	Southend-on-Sea I debby.dawson@olympus.co.uk
29 Jun	**Step-by-step hilic method development**	Cambridge I jsumner@hichrom.com
29 Jun	**Techniques for biomolecule characterisation**	Cambridge I jsumner@hichrom.com
13 – 15 Jun	**Three-day update for cervical cytology**	Bristol I swrctc@nbt.nhs.uk
12 – 15 Jun	**Laboratory diagnosis of faecal and blood parasites**	Liverpool I susan.reilly@lstmed.ac.uk
12 – 13 Jun	**Laboratory diagnosis of faecal parasites**	Liverpool I susan.reilly@lstmed.ac.uk
20 Jun	**NHS sickle cell and thalassaemia screening programme antenatal screening laboratory update day**	Leeds I cynthia.gill@phe.gov.uk
23 Jun	**NHS sickle cell and thalassaemia screening programme antenatal screening laboratory update day**	London I cynthia.gill@phe.gov.uk
29 Jun	**UK NEQAS quality assurance masterclass**	Sheffield I ukneqas@immqas.org.uk
30 Jun	**Immunochemistry and allergy annual participants meeting: how you can improve the patient experience**	Sheffield I ukneqas@immqas.org.uk
July		
10 – 12 Jul	**BMS/cytoscreener update course 5**	London I nwlh-tr.lrctcbooking@nhs.net
20 – 21 Jul	**Getting the most from your confocal course**	York I karina@rms.org.uk
25 Jul	**Basic concepts of HPLC**	Loughborough I jsumner@hichrom.com
25 Jul	**HPLC/UHPLC column care and maintenance**	Loughborough I jsumner@hichrom.com
25 Jul	**HPLC instrument basics and troubleshooting**	Loughborough I jsumner@hichrom.com
18 Jul	**Update course in gynaecological cytology – review cases (2)**	Birmingham I amanda.lugg@bwnft.nhs.uk
11 Jul	**Pharmaceutical data integrity**	Reading I jsumner@hichrom.com
4 Jul	**HPLC method development**	London I jsumner@hichrom.com
4 Jul	**Urinary cytology**	Bristol I swrctc@nbt.nhs.uk

August		
17 Aug	**UK NEQAS cellular pathology technique specialist workshop B**	Newcastle I chantel.hodgson@ghnt.nhs.uk
16 Aug	**UK NEQAS cellular pathology technique special staining beginners/refresher workshop**	Newcastle I chantel.hodgson@ghnt.nhs.uk
10 Aug	**UK NEQAS cellular pathology technique non-gynae cytology intermediate workshop**	Gateshead I chantel.hodgson@ghnt.nhs.uk
9 Aug	**UK NEQAS cellular pathology technique non-gynae cytology beginners/refresher workshop**	Gateshead I chantel.hodgson@ghnt.nhs.uk
September		
10 – 15 Sep	**Flow cytometry course 2-17**	York I karina@rms.org.uk
12 Sep	**One-day update course in thinprep gynaecological cytology evaluation of glandular cells in cervical samples**	Wakefield I kathryn.hawke@nhs.net
20 Sep	**NHSCSP diploma assessors induction training course**	London I nwlh-tr.lrctcbooking@nhs.net
27 Sep	**One-day medic's update course for pathologists/APs 2**	London I nwlh-tr.lrctcbooking@nhs.net
5 – 7 Sep	**Three-day update for cervical cytology**	Bristol I swrctc@nbt.nhs.uk
7 Sep	**UK NEQAS cellular pathology – immunocytochemistry staining beginners workshop**	Newcastle I chantel.hodgson@ghnt.nhs.uk
14 Sep	**Laboratory aspects of haemoglobinopathy diagnosis**	London I b.bain@imperial.ac.uk
15 Sep	**Morphology update 2017**	London I b.bain@imperial.ac.uk
October		
14 Oct – 27 Jan	**Biomed advanced human genetics course 2**	Online I biomed@gre.ac.uk I 020 8331 9978
14 Oct – 27 Jan	**Biomed analysis of nucleic acids course 2**	Online I biomed@gre.ac.uk I 020 8331 9978
14 Oct – 27 Jan	**Biomed blood transfusion course 2**	Online I biomed@gre.ac.uk I 020 8331 9978
14 Oct – 27 Jan	**Biomed chromatography-mass spectrometry analysis in healthcare settings course**	Online I biomed@gre.ac.uk I 020 8331 9978
14 Oct – 27 Jan	**Biomed clinical data interpretation course 2**	Greenwich I biomed@gre.ac.uk
14 Oct – 27 Jan	**Biomed diagnosis of breast cancer course 2**	Greenwich I biomed@gre.ac.uk
14 Oct – 27 Jan	**Biomed governance and risk management 2**	Greenwich I biomed@gre.ac.uk
14 Oct – 27 Jan	**Biomed implementing advanced quality management 2**	Greenwich I biomed@gre.ac.uk
14 Oct – 27 Jan	**Biomed lung disease 2**	Greenwich I biomed@gre.ac.uk
14 Oct – 27 Jan	**Biomed management of healthcare-associated infection 2**	Greenwich I biomed@gre.ac.uk
14 Oct – 27 Jan	**Biomed managing learning and development in healthcare 2**	Greenwich I biomed@gre.ac.uk
14 Oct – 27 Jan	**Biomed point of care testing 2**	Greenwich I biomed@gre.ac.uk
14 Oct – 27 Jan	**Biomed quality systems management 2**	Greenwich I biomed@gre.ac.uk
14 Oct – 27 Jan	**Biomed renal disease 2**	Greenwich I biomed@gre.ac.uk
14 Oct – 27 Jan	**Biomed robotics and automation 2**	Greenwich I biomed@gre.ac.uk
2 – 27 Oct	**Intro to gynaecological cytology (NHSCSP Diploma) 2**	London I nwlh-tr.lrctcbooking@nhs.net
5 Oct	**Superficially porous (core shell)**	Reading I jsumner@hichrom.com
5 Oct	**Techniques for biomolecule characterisation**	Reading I jsumner@hichrom.com
11 Oct	**Exploring eluent pH in method development**	Manchester I jsumner@hichrom.com
11 Oct	**Method development strategies to exploit selectivity**	Manchester I jsumner@hichrom.com
11 Oct	**Step-by-step hilic method development**	Manchester I jsumner@hichrom.com
12 Oct	**HPLC/UHPL troubleshooting**	Manchester I jsumner@hichrom.com
13 Oct	**HPLC method development**	Manchester I jsumner@hichrom.com
14 Oct – 27 Jan	**Biomed immunocytochemistry in diagnostic cellular pathology**	Online I biomed@gre.ac.uk
17 Oct	**Stepwise introduction to practical HPLC part 1**	Manchester I jsumner@hichrom.com
19 Oct	**The technique of GC in three parts: 1. fundamentals 2. troubleshooting 3. method development**	Loughborough I jsumner@hichrom.com
31 Oct	**UK NEQAS CPT annual participants meeting**	Edinburgh I cpt@ukneqascpt.org.uk
November		
27 Nov	**Non-gynaecological urine cytology for biomedical scientists**	Wakefield I kathryn.hawke@nhs.net
21 – 23 Nov	**BMS/cytoscreener update 7**	London I nwlh-tr.lrctcbooking@nhs.net

HERE TO HELP

TRAINING LABORATORY APPROVAL

Jocelyn Pryce, IBMS Head of Registration and Training, looks at ways the IBMS is working to reduce the pressures of the lab approval process.

This month I wanted to bring you all up to date with some changes that we have been trialling with respect to our training laboratory approval process. Those of you who are involved with laboratory management and training will, at some point over the last few years, have been involved in preparing the reams of documentation that we, as an education provider for the Health and Care Professions Council (HCPC), require to ensure our trainees experience an optimal training programme for their IBMS Registration Training Portfolio on which to build the foundations of their career in biomedical science.

As part of our review to ensure we provide quality, fit-for-purpose processes that satisfy the HCPC and benefit our members, we have been looking at ways to reduce the pressures of the laboratory approval process for both the laboratories and the IBMS Education Team. With the support of the Education and Professional Standards Committee (EPSC), and in consultation with members, we have successfully completed a pilot to ascertain whether there was an appetite for streamlining the current process.

We have developed a new-look form, which is hopefully more straightforward in requirements and will simplify the application process. The training programme appears to cause the greatest difficulty.

Historically, we have encouraged innovation and stipulated only that we need to see a demonstration of the areas of a laboratory that a trainee will be attached to, which standards they might achieve there and how this might be done. While many of you found this easy to demonstrate (usually in a tabular format), some found it more challenging and the team has spent many hours supporting laboratories along the process to produce a document which details these requirements and allows us to satisfy the needs of the HCPC.

Subsequent to the pilot, but prior to the latest EPSC meeting, we received a comment from a member suggesting that we consider "mapping" the training programme/experience directly to the portfolio, so that it is absolutely clear how each may be met.

Over the coming weeks, we will be working with members to trial this and to identify a streamlined process for laboratories to demonstrate that they have robust training in place for all levels, not just the pre-registration route. This seems to be an ideal way to satisfy all the requirements, while reducing and simplifying the processes, and so it looks to be a win-win situation.

I will stress at this point that we are aware training programmes are subject to alteration in response to service requirements and that any documentation supplied as part of the training programme will be considered as an intent, rather than set in stone.

I would like to thank everyone who took part in the pilot and who has contributed to the redevelopment process. I hope those of you who are responsible for the production of the laboratory approval documentation welcome this and that it provides you with a simplified new approach saving both time and effort. From our perspective, it will allow the approval procedure to be streamlined through the team and will result in faster turnaround times. IBMS

For more information, visit ibms.org/qualifications

IMAGE: ISTOCK

Diagnostics Directorate
Department of Laboratory Medicine
Glasgow Royal Infirmary

NHS Greater Glasgow and Clyde

Technical Services Manager – Haematology

North Sector – Band 8C, £57,232 - £70,559

Applications are invited from suitably qualified individuals for the post of Technical Services Manager within the Haematology Department, North Sector. This full time permanent post will be based at Glasgow Royal Infirmary and will be responsible for the delivery, management and ongoing development of a high quality and effective haematology and blood transfusion service across all sites within North Sector.

The post holder is responsible for making the best use of all resources including staff, equipment and consumables in an environment that is safe and conducive with best working practices. You will be responsible for the establishment and implementation of all service policies and procedures that are required to meet the standards of UKAS for continued accreditation and for development of the service.

The post holder will be the Professional Lead and line manager for Healthcare Scientists, managers and related staff for several departments – for example: Core Haematology, Specialist Haemostasis, and Blood Transfusion. This encompasses responsibility for recruitment, training, performance and professional development of staff. You will also oversee effective administration of all service related matters, including responsibility as budget holder for the department budgets.

The post holder will ensure implementation of relevant NHS policies and directives and to interpret and apply relevant organisational, local and national guidelines and policies.

It is essential that you have a BSc Honours Degree that meets the requirements of the Health Professions Council (HPC), Appropriate State Registration with the Health Professions Council is mandatory and Healthcare Science Masters Degree/Fellowship plus further professional training, development and experience to doctorate or equivalent level – Chartered Scientist Status is expected. As well as gaining further specialist knowledge the post holder must hold a Management qualification such as the Diploma in Management Studies (2 years p.t.) or the Diploma in Medical Laboratory Management (2 years p.t.) or have equivalent management training.

For more information about this post please call Jane Gibb, Assistant General Manager on 0141 354 9063 or e-mail jane.gibb@ggc.scot.nhs.uk

Job Description and further application information available at www.jobs.scot.nhs.uk and follow the link to NHS Greater Glasgow and Clyde, Job Reference No: 47022G.

The closing date for applications is 16th June 2017.

THE DOCTORS LABORATORY

BIOMEDICAL SCIENTIST – MULTIDISCIPLINARY

For further details on this role, contact Andrea Vickers by emailing andrea.vickers@tdlpathology.com

An opportunity has arisen for an experienced HCPC registered Biomedical Scientist based at our pathology laboratory at the **Ramsay Rivers Hospital**. This is a multi-disciplinary role that includes Biochemistry, Blood Transfusion and Haematology.

Duties will include working in Sample Reception, the routine operation, maintenance and troubleshooting of laboratory instrumentation, technical validation and clinical authorisation of results, stock control and ordering supplies. Experience in BT would be highly regarded. A competitive salary and benefits package will be offered to the successful applicant.

Closing Deadline: Sunday 18th June 2017

THE BIOMEDICAL SCIENTIST
THEBIOMEDICALSCIENTIST.NET

Would you like to advertise your vacancy here?

IBMS Institute of Biomedical Science

To discuss recruitment advertising in ***The Biomedical Scientist***, please contact Maegan Dunne on **+44 (0)20 7324 2755** or email **maegan.dunne@redactive.co.uk**

Raigmore Hospital, Inverness

NHS Highland

Blood Sciences Department

Quality Lead – Band 7

£32,013 - £42,205 (A relocation package may be available)

Full Time, Permanent

Applications are invited from HCPC Registered Biomedical Scientists having either an IBMS Higher Specialist Portfolio or a Masters Degree in Biomedical Sciences. Applications for those who are near completing their portfolio or Masters Degree will also be considered. The department for which you would be quality lead is spread across three acute hospital sites at Inverness, Wick and Fort William. Experience of working in a routine Blood Sciences department would be an advantage although those having worked in Biochemistry or Haematology will be considered. The post is based at Raigmore Hospital (Inverness) where the ability to work under pressure, desire to learn new skills in all areas of Blood Sciences, and good communication skills are essential.

The department is registered by both HCPC and IBMS as a training laboratory and although it has CPA accreditation is working towards UKAS accreditation.

Highland is an area of outstanding beauty with many opportunities for outdoor activities such as skiing, hill-walking, golf and fishing. Inverness and surrounding towns also offer cultural events at venues such as the Eden Court Theatre in Inverness. Good schools can be found throughout the area, and there is also the new campus for the University of Highlands and Islands at Inverness.

Inverness provides air and rail links with the rest of the UK.

Informal enquiries or to arrange a visit to the department: Mr. Michael Milner or Mr. Brian Morrison; tel: 01463 704158; email: mmilner@nhs.net or brian.morrison2@nhs.net.

Application forms and job descriptions can be downloaded via our website www.nhshighland.scot.nhs.uk or available from, and to be returned to, the Employment Services Section, John Dewar Building, Inverness Business & Retail Park, Highlander Way, Inverness IV2 7GE or by emailing your name and address to nhshighland.recruitment@nhs.net.

Please quote reference IM9_17_36.

Closing date for completed applications: 23 June 2017.

disability confident EMPLOYER

www.nhshighland.scot.nhs.uk

SENIOR BIOMEDICAL SCIENTIST - HISTOLOGY & NON-GYNAE CYTOLOGY – 1 vacancy

Band 7 + 10%, Benefits & Performance related bonus

To take an active and lead role in Quality Management as Quality Supervisor
Develop your portfolio with dissection and Mohs frozen sections
External Courses are also supported

Cellular Pathology Services Ltd is a fully CPA-accredited private laboratory transitioning to UKAS new standard ISO 15189:2012, which provides quality driven laboratory services to the independent and NHS sectors. Our facility is located in west Watford within modern premises.

Due to expansion we are looking for enthusiastic, forward thinking Biomedical Scientist with QMS experience to join our busy laboratory that provides routine Histology and Non-Gynae Cytology services. Experience in cutting frozen section is desirable.

Our staff have strong team spirit and show initiative with a "can do" attitude. You need to be a self-starter who has a flexible approach to the required hours of work and thrives under pressure. Flexible working patterns are in place to cover the laboratory from 7am to 7pm which you will be required to participate in.

The successful applicant must be state registered with HCPC and must have a wide experience in routine histological techniques, including immunohistochemistry, cut up, special stains and have knowledge of tissue recognition. Candidates must be eligible to work in the UK. You will need to have a driving licence as satellite laboratory support may be required.

Staff benefits: a competitive salary, annual performance bonus, pension scheme & health insurance.

For information/visit, contact the Laboratory on 01923 233299.

Application forms are available on:
www.cellpathservices.co.uk

Completed applications and your current CV should be sent to: Human Resources, Cellular Pathology Services Ltd, Unit 12 Orbital 25 Business Park, Dwight Road, Watford WD18 9DA

Alternatively these can be scanned and sent to:
HR@cellpathservices.co.uk

Diagnostics Directorate,
Immunology Department

NHS Greater Glasgow and Clyde

Health Care Science Professional Manager – Immunology and Neuroimmunology

Band 8A, £40,833 - £49,000

The Immunology and Neuroimmunology service is located in a new state of the art laboratory building which will be your main base. The service is co-located in an open plan laboratory area with Blood Sciences. Close working relationships are being developed with these services. The services provided from this building support the flagship Queen Elizabeth University Hospital and Royal Hospital for Children which opened in April 2015. The new hospital has been directly funded by the Scottish Government at a cost of approximately £800 million pounds with approximately £80 million of this total being used to build the laboratory building.

The Immunology and Neuroimmunology service provides a range of specialised assays that are available to clinicians throughout the UK and overseas and has very close links with the Institute of Neurological Sciences.

The post holder will be responsible for the application of the quality management, training and health & safety management systems of the Immunology and Neuroimmunology laboratories for NHS Greater Glasgow and Clyde. The remainder of the post holder's time will be taken up by managing a sub-division (technical section) of one of the laboratories. as directed by the Immunology Manager and will deputise for the Immunology Manager in their absence.

Applications are invited from candidates with an MSc or equivalent qualification who have extensive post HCPC registration experience in a relevant discipline. While a formal Quality Management qualification is a requirement for this post consideration will be given to candidates who do not currently hold a Quality Management qualification on the understanding that they would be required to undertake this qualification once in post.

For more information about this post please call Mr Colin Smith, Technical Services Manager, on 0141 354 9031, email colin.smith@ggc.scot.nhs.uk or Mrs Sylvia Arthur, Immunology Laboratory Manager, 0141 354 9103 email Sylvia.arthur@ggc.scot.nhs.uk.

Job Description and further application information available at www.jobs.scot.nhs.uk and follow the link to NHS Greater Glasgow and Clyde, job reference: 47094G.

The closing date for applications is 16 June 2017.

Raigmore Hospital, Inverness

NHS Highland

Blood Sciences Department

Biomedical Scientists – Band 6

£26,830 - £35,933 (A relocation package may be available)

Full Time, Permanent

Applications are invited from HCPC Registered Biomedical Scientists for two vacancies, one in Biochemistry and one in Haematology. You should already have a Specialist Portfolio. Applications for those who are near completion of their portfolio will also be considered. The posts are based at Raigmore Hospital in Inverness and you will be expected to work in a 24 hour shift system. The ability to work under pressure, and good communication skills are essential attributes.

The department is spread across three acute hospital sites at Fort William, Inverness and Wick providing a diagnostic Blood Sciences service to a population of approximately 235,000 people in NHS Highland and receives in excess of 430,000 requests annually. In addition to the routine work, the department is a Haemophilia Centre providing a specialist coagulation repertoire. All three sites are fully automated with tracked analysers at Inverness. It is registered by HCPC and IBMS as a training laboratory, CPA accredited and working towards UKAS accreditation. Participation in CPD activities is required and progression to attaining higher qualifications is encouraged.

Highland is an area of outstanding natural beauty with opportunities on the doorstep for activities such as skiing, hill-walking, golf and fishing. Inverness and surrounding towns also offer cultural events at venues such as the Eden Court Theatre in Inverness. Excellent schools can be found throughout the area, and also the new campus for the University of Highlands and Islands at Inverness.

Informal enquiries or to arrange a visit to the department: Mr. Michael Milner or Mr. Brian Morrison; tel: 01463 704158; email: mmilner@nhs.net or brian.morrison2@nhs.net.

Application forms and job descriptions can be downloaded via our website www.nhshighland.scot.nhs.uk or available from, and to be returned to, the Employment Services Section, John Dewar Building, Inverness Business & Retail Park, Highlander Way, Inverness IV2 7GE or by emailing your name and address to nhshighland.recruitment@nhs.net.

Please quote reference IM9_17_37.

Closing date for completed applications: 23 June 2017.

disability confident EMPLOYER

www.nhshighland.scot.nhs.uk

MY LAB

TEACHING AND RESEARCH

Dr Lisa Coulthwaite, Principal Lecturer, School of Healthcare Science at Manchester Metropolitan University, takes a tour of the microbiology labs.

The microbiology laboratories in our School of Healthcare Science support a wide range of undergraduate and postgraduate degree programmes and are home to a vibrant community of researchers and academics.

Manchester Metropolitan University represents one of the highest concentrations of health research excellence in the UK: three years ago, its research in allied health professions and biomedical science was ranked 12th out of all universities by the *Times Higher*. The university's thriving healthcare science research underpins teaching and engagement with industry. Students benefit from a strongly interdisciplinary environment in a faculty engaged with the NHS, industry, international partners, its city and region, and government. There are trailblazing specialisms in microbiology, musculoskeletal science, advanced materials and vascular science.

Microbiology at Interfaces is our elite research group and a truly interdisciplinary team encompassing antimicrobials and drug repurposing, microbiomes, biofilms and metagenomics. The group comprises 15 academic staff, three postdoctoral scientists and 16 associates across other disciplines. We also have PhD students and Masters students who are studying by research (as opposed to taught programmes). We work with industry and academics around the world and our research ensures our microbiology teaching is bang up to date.

We are a large school with 1,400 students and our biggest cohort is for biomedical science – both our undergraduate and postgraduate degrees are IBMS accredited.

Medical microbiology is taught at all levels and we have an IBMS-accredited MSc in Medical Microbiology. We focus on the role of microbiology in the diagnosis and treatment of disease and the pathogenic changes that occur as a result of interactions between host and pathogen. Our optional study units are more research-led, covering microbial interfaces in medical and food environments, infection prevention and control, novel and phage-based antimicrobials, and pathogen and phage genomics.

Our laboratory classes are an excellent learning environment for students to consolidate their theoretical understanding and develop technical skills in safe manipulation of microorganisms, performing techniques with accuracy and with correct interpretation.

Our students can undertake a wide range of laboratory research projects from traditional culture-based microbiology to molecular and genomic research. We run live projects in collaboration with local pathology departments and other projects link with current research at the university.

Catrin Austin studied MSc Biomedical Science and is now a second-year PhD student in the School of Healthcare Science. Catrin comments: "One of the things I enjoy most about the university is the sense of community – we have seven different floors of laboratories and they're all very open to working with each other."

Our labs are supported by an excellent team of friendly, highly-skilled technical staff, who make running practical classes easy and enjoyable.

I particularly enjoy laboratory teaching in microbiology and it is a great feeling when students have also enjoyed learning and say so at the end of a class. IBMS

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