ONE-TO-ONE

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THE BIOMEDICAL SCIENTIST

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OCTOBER 2019

GONE SURFING

Goodbye to the controversial Nobel Prize-winning chemist who unlocked DNA while living a life of surfing, wine and LSD

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COVER IMAGE: HIT AND RUN MEDIA/HITANDRUNMEDIA.COM

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PUBLISHED BY
Redactive Publishing Ltd
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ISSN 1352-7673

PRINTED BY
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INNOVATIONS IN CELLULAR PATHOLOGY

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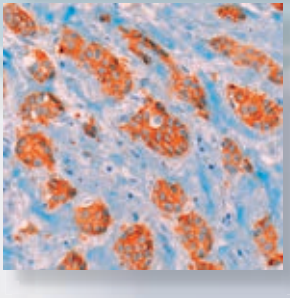

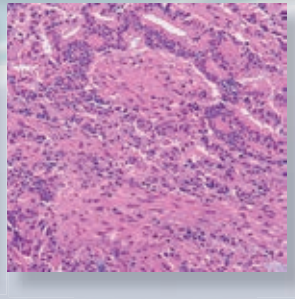

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AGGRESSION IS THE NORM

Society is squinting through a lens of scepticism and looking for ulterior motives, writes the IBMS' Sarah May.

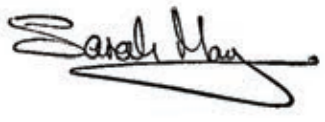
I really should give up reading the news, it's not good for my health. Surely I am not alone in feeling the oppressive weight of the constant drip of bile and negativity that seems to permeate every story. It feels that, as a society, we have become immune to anything that could be construed as positive and instead prefer to squint intensely through the strong lens of scepticism looking for ulterior motives.

At this point you're probably thinking I must be writing this at the end of a particularly bad day but this is actually the product of a week during which the Duchess of Sussex has been vilified again for some charitable work she is doing, a pop star admitted she had been driven to suicidal thoughts due to the relentless and hateful criticism of her appearance and a former rugby captain had emotionally "confessed" to being HIV positive to counter blackmail threats to "out" him. And all this comes on top of the almost daily news of stabbings, which are now rapidly becoming almost a part of normal life.

However, my tipping point was the news this morning wherein it was stated that someone (I can't remember who) would be "having their feet held to the fire" today. This is not the first time I have heard that revolting expression used and I wonder if the language and behaviour of leaders, and the media that surrounds them, is seeping in to everyday life and skewing our perception of what is acceptable.

I have frequently heard people say with pride "I like to say it as it is"; in my mind that means having personal carte blanche to be rude or hurtful without restraint in the cosy, misguided belief that people "know where they stand". Is it any wonder that aggression has almost become the norm when hardly a month goes by without us hearing of a person in power who has abused their position by bullying or being thoroughly unpleasant? But then I suppose that when the leader of the free world communicates with regular monotony using a barrage of angry and aggressive tweets, we could all be forgiven for thinking this is acceptable behaviour.

The bottom of the barrel was surely scraped though when a newspaper editorial suggested that David Cameron's grief over the death of his young son was somehow lessened by his position of privilege. Wow, that really takes the biscuit. Irrespective of our political views, gender, religion, or our position in society, we all bleed when cut – whether that cut is physical or emotional. Thank goodness for the "Good Deed Feed" in my daily commute reading material; it reassures me that despite the nastiness there are still lovely people out there.



Sarah May
Deputy Chief Executive

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

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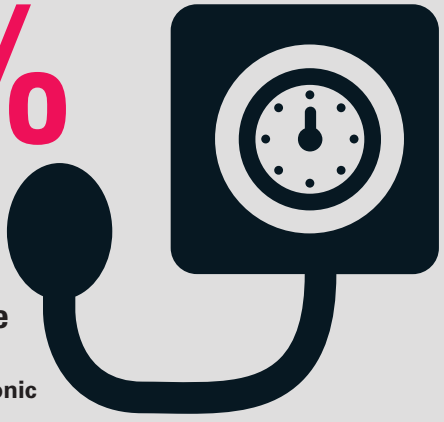
SCIENCE NEWS IN NUMBERS

75%

High blood pressure among older pregnant women has increased by more than 75% since 1970. The rate of **chronic hypertension** among **pregnant women aged 35** and over in the **US** has increased considerably, with **black women** suffering from **persistent high blood pressure** at more than **twice the rate of white women.**



A teenager began losing his hearing at the age of 14 after living off a diet of chips, crisps and sausages. His **eyesight** also quickly deteriorated and he has now been left **blind** and **deaf**. His mother said he began going off his meals when he was about seven-years-old and he has since been diagnosed as suffering from an eating disorder known as ARFID (avoidant-restrictive food intake disorder).

30 YRS

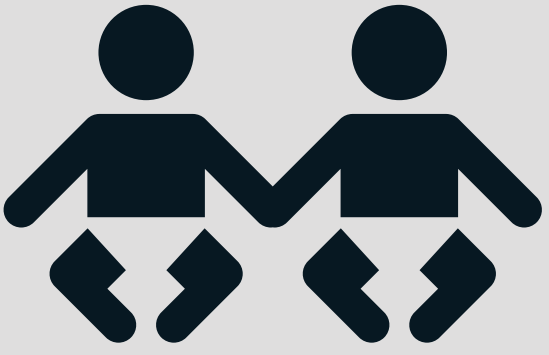
The children of women who experience severe stress when pregnant are nearly 10 times more likely to develop a personality disorder by the age of 30. More than **3600** pregnant women in **Finland** were asked about their **stress levels**, and their children followed up. **Personality disorders** are thought to affect **one in 20**.

At least 17 children

developed so-called "werewolf syndrome" after a major medicine mix-up in Spain. The **children** began **growing hair** all over their body after being given what was thought to be **omeprazole**, a drug that helps with **gastric reflux.** After investigating, authorities discovered the treatment actually contained **minoxidil,** a medication used for the treatment of **hair loss.**

1,435

Nearly 1,500 people in France are thought to have died due to record heatwaves over June and July. The country's **health minister** said half of those who died were **over 75**. France recorded its highest-ever temperature of **46C (114.8F)** in June.



73

An Indian woman aged 73 has given birth to healthy twin girls. Mangayamma Yaramati and her husband, **aged 82**, had always wanted to become parents but were unable to conceive. She described it as "the happiest time of my life".

CANCER

Blood test aids lung cancer detection

A trial in Scotland has shown that using a blood test to detect lung cancer earlier can significantly reduce late-stage presentation of the disease.

The Early Detection of Cancer of the Lung Scotland is the world's largest clinical biomarker trial looking into detecting early lung cancer using a blood test.

Scotland has one of the highest rates of lung cancer in the world – 2,592 men and 2,739 women were diagnosed with the disease there in 2017 – and 12,000 volunteers agreed to take part in the study.

"This study moves us closer to making an earlier diagnosis of lung cancer which could have a significant impact in saving lives," said Professor Frank Sullivan, co-chief investigator. "Lung cancer has been notoriously difficult to spot early and to treat. The question we need to answer next is whether a combination of blood testing and imaging can offer a real step-change in lung cancer diagnosis."

See page 16 for an interview with Professor Frank Sullivan.

→ **eclsstudy.org**

SCIENCE NEWS

ERADICATION

DEFEAT MALARIA IN A GENERATION

The world could be free of one of the oldest and deadliest diseases to affect humanity within a generation.

Each year there are more than 200 million cases of malaria, which mostly kills young children.

But a major report says eradicating malaria is now a possibility, although it will probably need an extra £1.6bn of annual funding.

Steady progress has been made – since 2000 the death rate from the disease has fallen by 60% and the number of countries with malaria has fallen from 106 to 86.

The World Health Organization report was published in *the Lancet*, and features 41 malaria experts who conclude eradication could be achieved by 2050.

However, one of the report's authors, Sir Richard Feachem, warned it would take "bold action" in order to achieve the goal requiring current technologies to be used more effectively and the development of new ways of tackling the disease.

→ **bit.ly/2k6PeMt**

CARDIOVASCULAR

GRADUAL HEART ATTACK STILL AN EMERGENCY

Patients with gradual heart attack symptoms are taking over three times as long to get medical help compared to those with abrupt symptoms.

Although both are medical emergencies a study has revealed that those with gradual symptoms took, on average, eight hours to get help compared to 2.6 for those with sudden symptoms. A maximum delay of two hours is recommended to get fast treatment, while serious complications and death are more likely beyond this window.

Gradual symptoms begin with mild discomfort that slowly gets worse, while abrupt onset refers to sudden and severe pain from the start.

"Both are a medical emergency and require urgent help," said Dr Sahereh Mirzaei, author of the study which was published in the *European Journal of Cardiovascular Nursing*. "But our study shows that gradual symptoms are not taken seriously."

→ **bit.ly/2khdRGv**

IMAGES: ISTOCK/SHUTTERSTOCK

MICROPLASTICS POLLUTION

THE DANGER IN OUR DRINKING WATER

Plastics in our wastewater are breaking down into tiny particles and causing potentially catastrophic consequences for our health.

These are the findings from a joint project by the University of Surrey and Deakin's Institute for Frontier Materials. The team found that tiny pieces of plastic break down further during treatment processes, reducing the performance of treatment plants and impacting on water quality.

In the past there have been numerous studies of microplastics pollution, but their interaction with water and wastewater treatment processes have not been fully understood until now.

"The presence of nano- and microplastics in water has become a major environmental challenge," said Dr Lee, Project Lead and Senior Lecturer at the University of Surrey. "Due to their small size, nano- and microplastics can easily be ingested by living organisms and travel along water and wastewater treatment processes."

→ **bit.ly/2ku5PKx**

CYSTIC FIBROSIS

"LIFE CHANGING" DRUG DEAL

Families have welcomed a deal which will make two "life-changing" cystic fibrosis drugs available to eligible patients in Scotland.

A five-year agreement has been reached between the Scottish government and pharmaceutical company Vertex over the use of Orkambi and Symkevi.

The drugs improve lung health but were rejected for NHS use recently because they were not deemed cost-effective. The medication normally costs £100,000 per patient per year but the Scottish government said it had secured a "confidential discount" from the manufacturer. Patients in other parts of the UK are not able to access the treatment.

Cystic fibrosis is a life-shortening genetic condition that causes fatal lung damage and affects about 10,400 people in the UK – around 900 of whom are in Scotland.

→ **bit.ly/2kwuCxA**

WHAT'S HOT AND WHAT'S NOT

HOT

GORILLAS

A team of scientists has demonstrated that female gorillas are able to detect and avoid sick groups and join healthier ones.

HOT

JK ROWLING

The author has donated £15.3m to support research into neurological conditions at an Edinburgh MS centre named after her mother.

HOT

BAT WINGS

A new study finds the muscles in bats' wings operate at a lower temperature than their bodies, which could help scientists improve the regulation of human exercise in the cold.

NOT

EXERCISE

Exercising while restricting calories could be bad for bone health, according to a new study published in the *Journal of Bone and Mineral Research*.

NOT

MICROPLASTICS

It's been shown that the presence of commonly used plastics can stunt the growth of earthworms, plant growth and the pH of soil.

NOT

SOCIAL MEDIA

Adolescents who spend more than three hours a day using social media may be at a higher risk for mental health problems, according to a US study.

MENOPAUSE

TESTOSTERONE PLEA

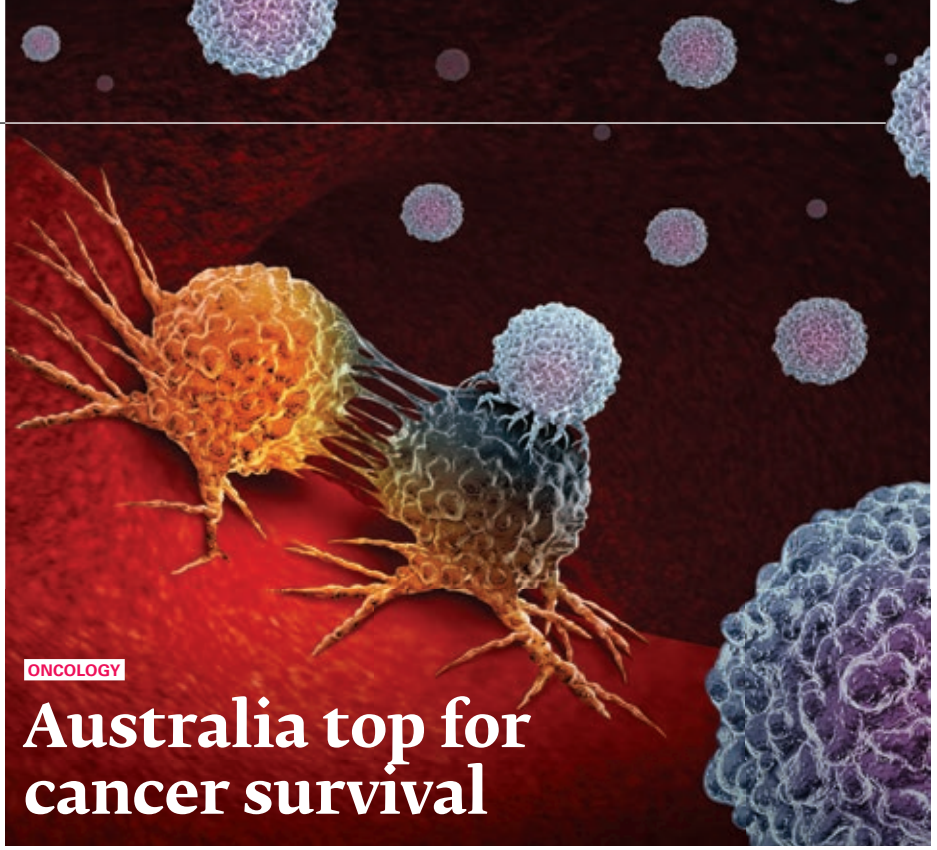
Calls have been made for testosterone to be licensed in the UK for post-menopausal women.

Experts say the hormone is an important treatment for those experiencing reduced libido in midlife.

A taskforce brought together by the International Menopause Society (IMS) found testosterone could help women with hypoactive sexual desire dysfunction (HSDD) – characterised by a reduced interest in sex after menopause. HSDD affects about 32% of women in midlife, but testosterone for women is not licensed by the UK's regulatory authorities.

The IMS statement on the hormone for women confirms post-menopausal women with HSDD can benefit from improved sexual desire, arousal, orgasm and pleasure, as well as reduced distress about sex.

Susan Davis, IMS President, said: "This statement reassures clinicians that a trial of testosterone therapy is appropriate for women with HSDD."
bit.ly/2mf8x7f



ONCOLOGY

Australia top for cancer survival

A global study has found that Australia's high cancer survival rates are attributed to early detection.

The study, published in the *Lancet Oncology* journal, also showed that Australia has better cancer survival rates than other similar high-income countries.

It reviewed 3.9 million cancer cases from Australia, New Zealand, UK, Norway, Ireland, Canada and Denmark and compared the one-year and five-year survival rates for seven types of cancer: bowel, oesophageal, pancreatic, stomach, rectum, lung and ovarian.

Australia had the highest five-year survival rate in all but lung and ovarian cancer, while the UK had the lowest five-year survival rate in five of the cancers.

Professor Sanchia Aranda, the Chief Executive of Cancer Council Australia, said the higher survival rates could be attributed to early detection, which she said was due to the management of referral and screening services in Australia.
→ **bit.ly/2kIO6yR**

3.9m

3.9 MILLION CANCER CASES WERE COMPARED ACROSS **SEVEN TYPES OF CANCER**: BOWEL, OESOPHAGEAL, PANCREATIC, STOMACH, RECTUM, LUNG AND OVARIAN.

UNDER THE MICROSCOPE

This month: GutFeelingKB

I had a gut feeling you would...
Let's stop right there. This is important stuff. GutFeelingKB offers data about the different types of organisms present in a person's gut as well as a comparison of their microbiome with other individuals.

Has it been in the news?
It certainly has. A research team led by George Washington University has crunched a lot of data to give an accurate census count of the bacteria residing there.

I suddenly feel a little queasy...
Indeed. They found 157 different types of organisms (eight phyla, 18 classes, 23 orders, 38 families, 59 genera and 109 species) living inside the guts of healthy volunteers.

Who were these lucky souls?
Participants were mostly people on campus. They recorded what they ate and drank daily and complemented their food journals by providing faecal samples from which DNA was extracted.

Wouldn't it have been more balanced to have taken some less than healthy volunteers?
It's all about building a knowledge base. In their paper the scientists are saying that by looking at healthy people they should be able to establish a baseline about what a healthy gut microbiome should look like and how things change under different conditions.

But what good would all this do?
By determining what exactly is in your stomach it should ultimately improve public health. One thing they could use the data for is to understand how the bacterial population in the gut changes after antibiotic treatment. Perhaps, with probiotics, they could encourage the right bacteria to grow?

I think I've had a bellyful...
It might well benefit you one day as the information may serve as a reference list for doctors, patients and researchers.

IMAGES: ISTOCK/SCIENCE PHOTO LIBRARY

HM Government

BREXIT 31 OCTOBER

BIOMEDICAL INDUSTRY

Permits will be required to move certain protected items between the UK and the EU

After Brexit, more than 35,000 protected species and their products will require a CITES permit to move to and from the EU. They'll also have to travel through designated ports and airports.

Find out which protected items will need a permit and how to apply for one at gov.uk/brexit-cites

Get ready for Brexit

TECH NEWS

IKA

NEW PIPETTES

The IKA pipette range now comprises 18 colour-coded models and includes large displays, durable construction and ergonomic handles to make the PETTE fix and vario suitable for frequent pipetting.

All PETTE models are fully autoclavable and can be easily sterilised. The large mechanical volume display is easy to read during pipetting.

This level of visibility ensures enhanced accuracy, precision and safety when pipetting.

→ **ika.com/en**

PNEUMAGEN

PROOF-OF-CONCEPT

Pneumagen has announced *in vivo* data on its lead product, Neumifil, generated from its proprietary GlycoTarge platform.

Neumifil is a first-in-class mCBM40 for the universal treatment of respiratory tract infections, including influenza virus and respiratory syncytial virus.

The study results demonstrate that Neumifil significantly reduces replication of respiratory syncytial virus in mice, a standard model for respiratory syncytial virus in humans.

→ **pneumagen.com**

OXFORD GENETICS

OXGENE BRAND LAUNCH

Oxford Genetics has announced the launch of its brand, OXGENE. The new brand articulates the company's powerful ability to combine highly innovative science with an engineering approach.

It celebrates the company's evolution from a product-based business model to providing high-quality, custom precision engineering services, and reflects the company's expanded scientific offering and ambition for the future.

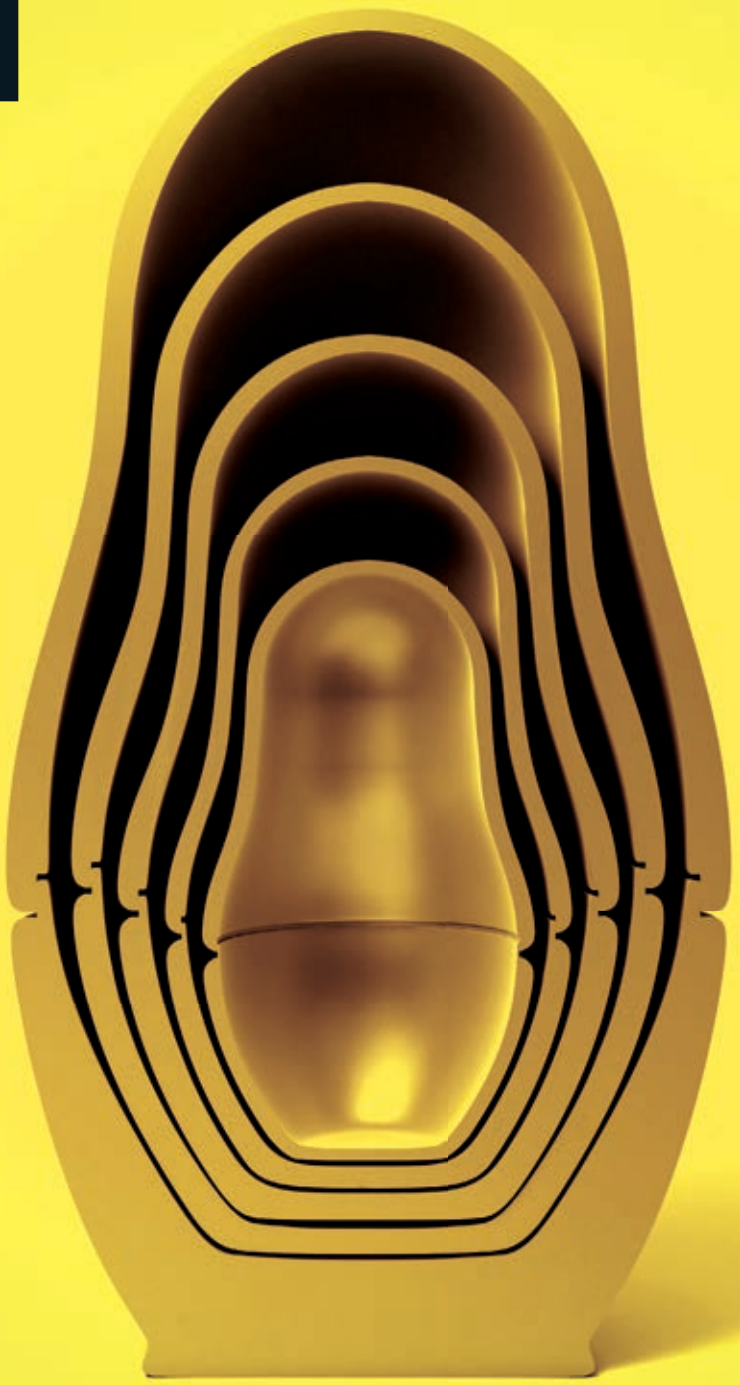
OXGENE has leading expertise in gene therapy, gene editing and antibody discovery.

→ **oxgene.com**

THE BIG QUESTION

THIS MONTH WE ASK

"What should our core professional values be?"



Sue Jones

Subject Director for Biomedical Science
York St John University

As either a biomedical science practitioner or a member of academic staff delivering biomedical science programmes, I believe that the basis of good core professional values lies in partnership and cooperation.

A quick "Google" of good professional values throws up the expected words and concepts: strong work ethic, dependability and responsibility, positive attitude, adaptability, honesty and integrity, self-motivated. It is striking how these values fit directly with our profession and the standards we set ourselves.

In both pathology laboratories and in academia, we work in diverse roles to deliver work and outcomes to agreed quality standards and timescales. It is embedded in our roles to continuously improve through a commitment to CPD and lifelong learning.

I firmly believe the phrase: "You can't be, what you can't see". We should lead by example to influence others. By working collaboratively and inclusively with a variety of colleagues, we can enhance both our own practice and that of others. Even if we don't line manage colleagues, we can secure commitment to and involvement with initiatives by using positive influence and encouragement.

In my role, I am passionate about supporting and promoting colleagues across my institution and (inter)nationally. My ultimate aim is to develop students who are enthusiastic, achieving their potential, highly employable and with a passion for what they do.

IMAGE: ISTOCK

Hedley Glencross

Advanced Specialist Biomedical Scientist
Portsmouth Hospitals NHS Trust

The word professional has its origins in the Greek word "to profess" or make a declaration, something still done by medical doctors when they take the Hippocratic Oath. Although Institute members do not make a similar declaration upon joining, like all professionals, they are afforded privileges not available to ordinary members of the public.

As such, their behaviour in their working life must be exemplary, which is not always necessarily fully articulated by the profession itself, instead relying on a code of conduct or professional standards. However, professional values are not the same as professional standards, as they say more about the individuals themselves. Key values that must be inherent in Institute members would be the social norms, expected of any individual, such as courtesy, honesty, integrity, probity, transparency and fairness, which help guide their daily professional work. But as professionals, Institute members must also be self aware too, recognising the limits of their capability or responsibility, seeking help when needed and learning from errors, mistakes or incidents.

Equally professionals must engage in life-long learning and development, taking all opportunities to acquire knowledge or skills and putting these into practice in their current or future roles. As a final thought, perhaps the most important professional value is that of leadership. Institute members must recognise that they are leaders in all of their actions and interactions by exhibiting and instilling these professional values in others.

Malcolm Robinson

Founder of Harvey's Gang
Volunteer at the Western Sussex NHS Foundation Trust

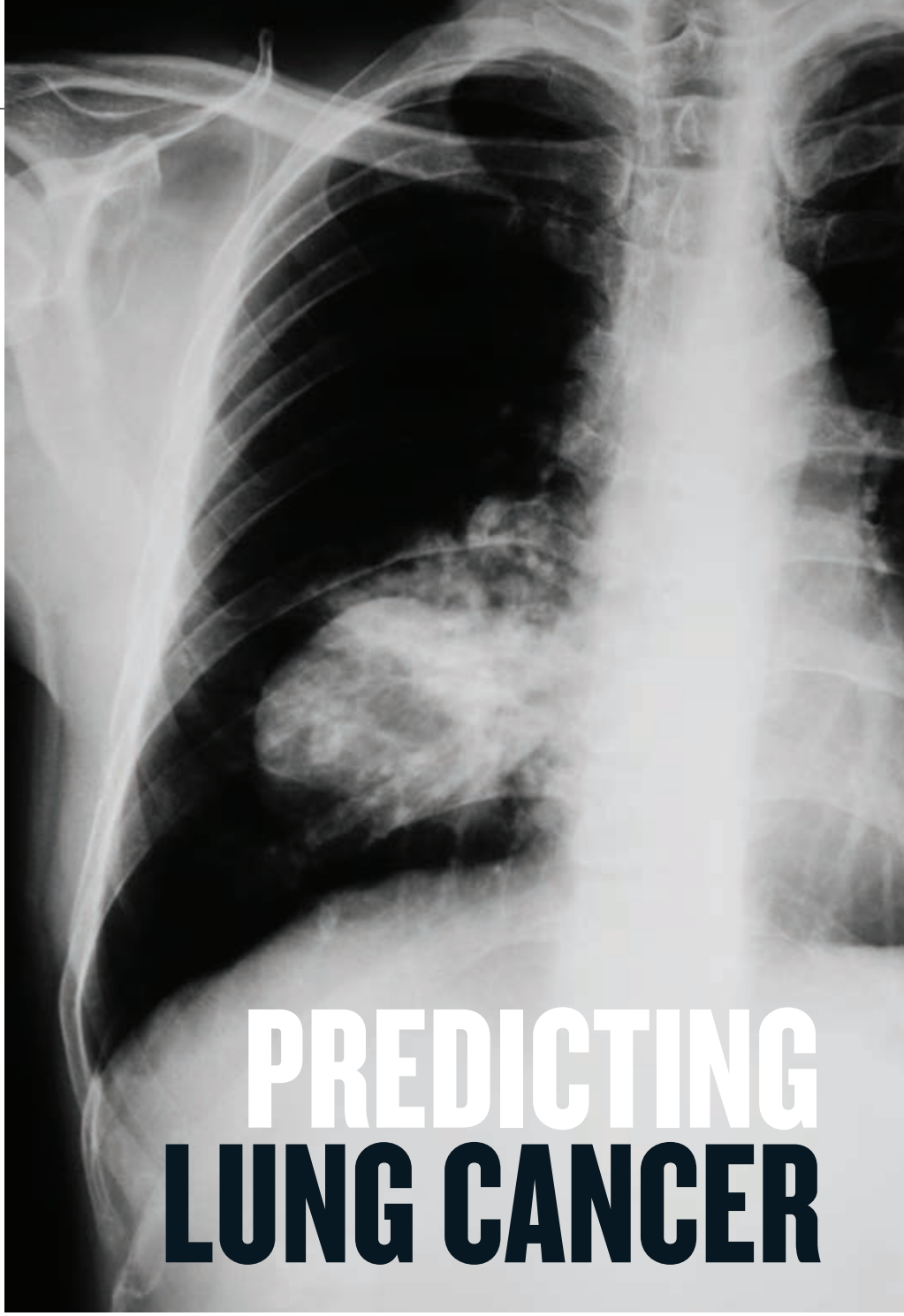
In my opinion, our fist core value is to be willing to serve – to promote patient wellbeing. We are scientists who should strive to put the patient first, every time. No excuses.

As biomedical scientists we must be driven to help patients by supplying a first-class service, not just diagnostics, not just by treatment and its effectiveness and ongoing monitoring, but through the whole patient journey, for their life.

Our second core value is communication. We must be able to communicate to ensure our patients benefit, with patients all receiving a great service using all modern tools available to us. We must communicate across teams within trusts, across healthcare trusts and across specialisms across the world.

Our third core value is teamwork. We are not robots just to serve at the wish of our trust executives, we are a team, from the top CEO to the bottom and vice versa and across healthcare, from one organisation to many others and back. We all have a valuable and vital part to play in the overall patient journey, trust each other and sign up.

It maybe cliché, but I do belief in TEAM, (Together Everyone Achieves More). Together we do achieve the best for our patients, they trust us. We all have a part to play in ensuring that our services are quality-driven and safe and that the services offered are timely, cost effective and, therefore, sustainable.



PREDICTING LUNG CANCER

Frank Sullivan, a Director of Research at the University of St Andrews, outlines a new blood test his team has developed that could lead to earlier lung cancer diagnosis.

In the UK, more than 35,000 people succumb to lung cancer each year. The disease often leaves doctors powerless because, in many cases, it is diagnosed too late, when there isn't much hope of successful treatment.

However, this might be about to change. A team co-led by Professor Frank Sullivan, the Director of Research at the University of St Andrews School of Medicine, has now shown that it is possible to diagnose lung cancer in high-risk patients before the symptoms even appear, using a blood test known as the EarlyCDT Lung test. A total of 12,209 participants were recruited as part of a clinical biomarker trial – the largest of its kind – to test this new diagnostic tool.

For the last seven years, Sullivan has been immersed in this work, so he is well aware of the devastating impact that a late diagnosis can have on patients and their families. "Lung cancer is one of the most problematic cancers in terms of getting an early diagnosis. In total, 80% of all cancers are stage III or worse by the time they are diagnosed," Sullivan points out.

A possible reason is that the incidence of lung cancer is higher in areas that are socially and economically deprived, and this is also where people tend to seek help for symptoms at a later stage of illness and so fail to obtain help for their medical problems early enough.

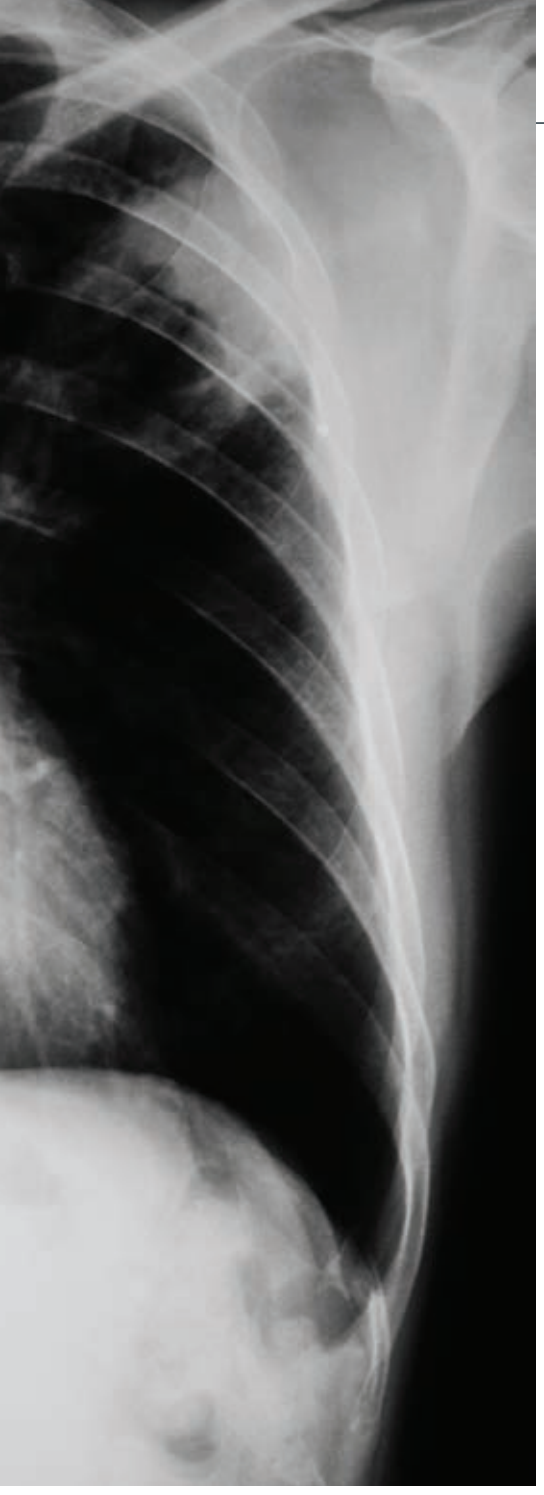
The need for quicker diagnosis

Introducing a diagnostic test that is quick and easy to use, which could be offered to patients who have a high risk of developing the disease, is considered a priority in order to improve patients' outcomes and curb mortality.

In the UK, survival from lung cancer is poor. Less than 9% of patients are still alive at five years after receiving their diagnosis. However, research has shown that those who are caught early can survive more than 10 years, with appropriate treatments.

"We used to think that there was no point in diagnosing lung cancer early, since we didn't have the means to treat people. But great improvements have been made, and we can now treat the disease quite well with a mix of surgery, chemotherapy, radiotherapy and immunotherapy. With an early diagnosis, we can now have cure rates of 60% to 70%," Sullivan says.

The EarlyCDT Lung test is a first step in



reaching those objectives, which is why trialling it on a large scale is so important.

A new hope

In the trial led by Sullivan, more than 12,000 participants were recruited across Scotland to take part in the study in the areas of Tayside, Greater Glasgow and Clyde, and Lanarkshire. They were all aged 50 to 75 and had a high risk of developing lung cancer over the next 24 months. "These were people who were or had been smokers and/or had a family history of lung cancer. They had smoked a pack of cigarettes a day for 20 years and tended to be living in a more deprived area. However, we excluded from the trials those who had another serious disease that would have made them unsuitable for surgery," Sullivan points out.

The test was developed as a simple ELISA blood test, looking for specific antibodies involved in the underlying biological processes of the disease. Oncimmune, who designed and developed the EarlyCDT Lung test, had approached the Scottish government in order to launch a trial, emphasising Scotland's poor record with lung cancer mortality.

Working in collaboration with researchers at the universities in Dundee, Glasgow, Aberdeen, Nottingham and Toronto, as well as with NHS Scotland, the Scottish Government and the Canberra Hospital, Sullivan and his team randomised the participants into two groups. Their objective was to demonstrate the difference after 24 months between people who had received the blood test versus those who had received the standard NHS care – that is no intervention until symptoms appear.

Patients who took the test and had a positive result were then offered a chest X-ray followed by a CT scan. If the initial CT scan returned with a negative result, they nevertheless received subsequent CT scans every six months for the duration of the trial.

The researchers found that the test could accurately identify 32% of lung cancers which occurred during the two years in the trial. Among those who had received the EarlyCDT Lung test and went on to develop lung cancer, 41.1% were diagnosed at an early stage. This was only the case for just over a quarter of those in the control group, who received standard care.

For Sullivan and his colleagues, these results are convincing enough to warrant a larger population-based study to test the cost-effectiveness of this measure. "This was an individually randomised controlled trial, and now we want to conduct a population study with more than one round of screening. We would like to gradually include more groups to start using the test, and it will be a complex design, but eventually it may allow us to get robust evidence to start using this test routinely in the clinic and to start saving more lives," Sullivan says.

In the long term, the goal would be to roll out the test more widely in Scotland and beyond, with the potential to revolutionise lung cancer diagnosis and treatment, and to reduce the healthcare costs associated with this devastating disease.

"We need to continue with our investigations, and carefully assess how this initiative should be offered to be entirely optimal, but this has the potential to bring huge benefits to patients. It's a new hope for the medical community that we can be better equipped in our struggle against lung cancer," Sullivan concludes. BMS

PROFESSOR FRANK SULLIVAN

- ✔ An academic general practitioner since 1984, Prof Sullivan completed his PhD in Glasgow in 1991
- ✔ Professor of Primary Care Medicine at the University of St. Andrews since 2017
- ✔ He received the British Medical Association Research Paper of the Year award in 2009 for his *N Engl J Med* paper on Bell's palsy
- ✔ Member of the NCRI Lung Cancer Clinical Studies group.

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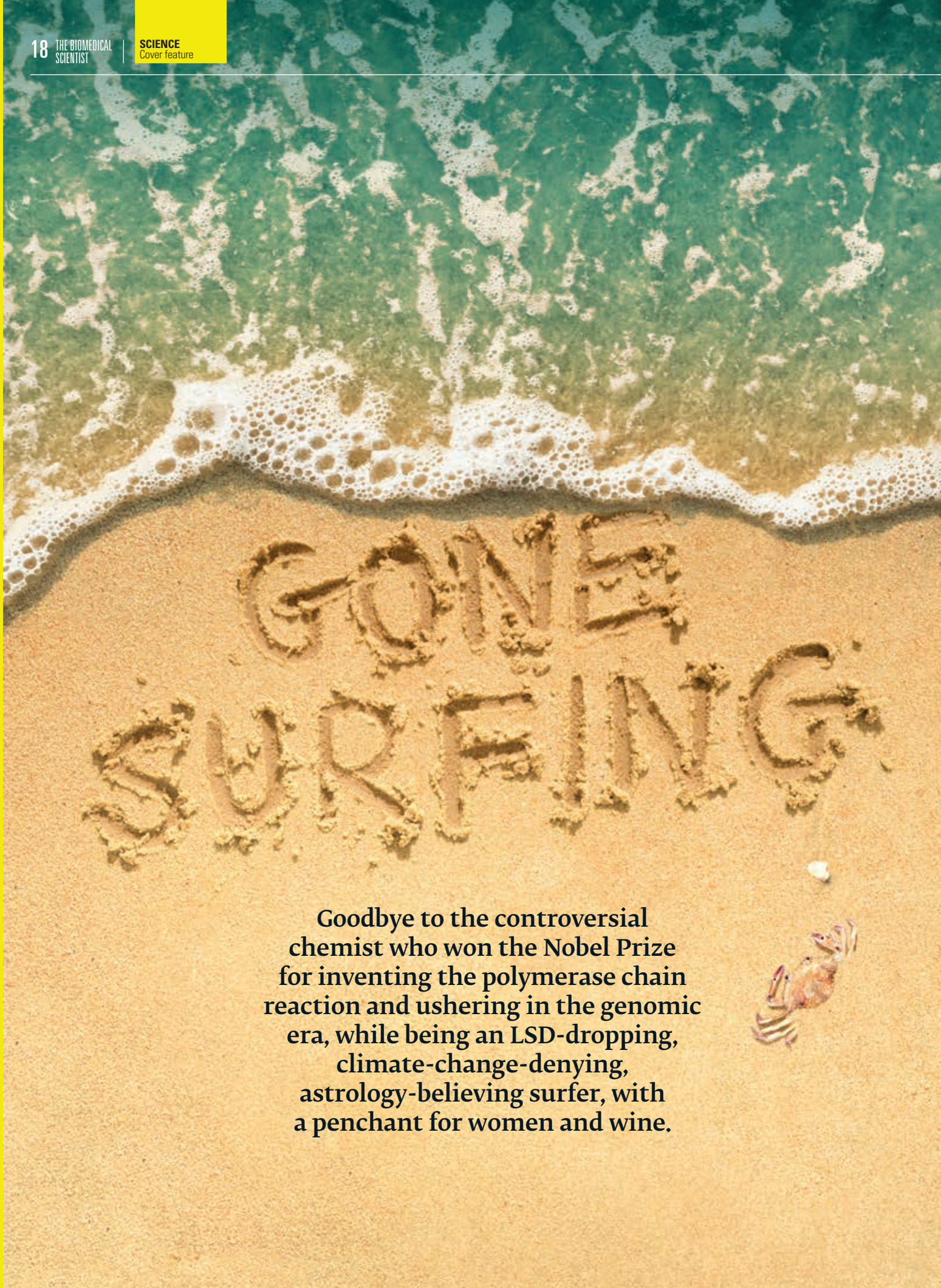

Goodbye to the controversial chemist who won the Nobel Prize for inventing the polymerase chain reaction and ushering in the genomic era, while being an LSD-dropping, climate-change-denying, astrology-believing surfer, with a penchant for women and wine.

It is midnight, deep in the woods, and "at the far end of the path, under a fir tree, there was something glowing ... It seemed to be a raccoon ... The raccoon spoke. 'Good evening, doctor,' it said. I said something back, I don't remember what, probably, 'hello'." The author admits, "I can't make glowing raccoons appear. I can't buy them from a scientific supply house to study... But I don't deny what happened."

The episode comes from *Dancing Naked in the Mind Field,* the 1998 autobiography of Dr Kary Banks Mullis, a Nobel laureate who died at his California home on 7 August from heart and respiratory failure. Notwithstanding talking raccoons that glow in the dark, what nobody denies is the monumental scientific legacy left by the "unconventional" scientist.

Mullis was awarded the 1993 Nobel Prize in Chemistry for his invention of the polymerase chain reaction (PCR), a pivotal point in the history of biology and medicine. As DNA pioneer Professor James Watson observed when he addressed the 1993 COGENE symposium, celebrating 40 years of molecular genetics: "It has been the ever-increasing sophistication of recombinant DNA techniques, bolstered by the 1985 polymerase chain reaction of Kary Mullis, as well as improvements in DNA sequencing procedures, that have led us into the genome era."

But according to a *Los Angeles Times* obituary, Mullis was also "an LSD-dropping, climate-change-denying, astrology-believing, board-surfing, Nobel Prize-winning chemist, who was both widely respected and equally criticized for

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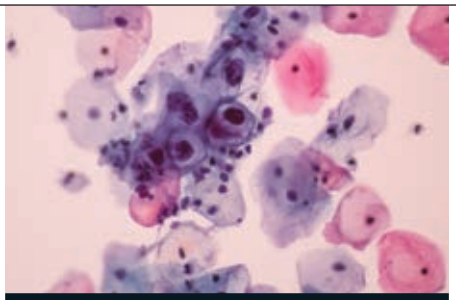
his controversial views." It's perhaps worth remembering, however, that Isaac Newton believed in alchemy, and the discoverer of oxygen Joseph Priestley held to the bogus doctrine that gases burned into "phlogiston".

Early days

Kary B Mullis was born in 1944 in Lenoir, North Carolina, and by the 1950s the family had moved to Columbia, South Carolina, where the Mullis brothers enjoyed playing outdoors. When seven-year-old Kary received a chemistry set for Christmas "my objective with that set was to figure out what things I might put together to cause an explosion". A career with chemicals beckoned.

In 1966, having gained a BS in chemistry from Georgia Institute of Technology, Mullis enrolled for a PhD at the University of California, Berkeley, researching the structure and organic synthesis of microbial iron transport agents. An early sign of Mullis's precocious and wide-ranging intellect was evident from his first publication – while a graduate student – in the journal *Nature*, where he considered the topic of reversing time.

Between 1972 and 1979 Mullis was variously a biochemistry lecturer at the University of California, Berkeley and post-doctoral fellow at the University of Kansas Medical School and the University of California, San Francisco, respectively.



"PCR WAS A GAME-CHANGER"

Professor Heather Cubie is an expert on human papillomavirus (HPV) detection and cancer prevention, having worked on many Scottish studies and on cervical screening and same-day treatment in Malawi.

"I worked on amplified DNA detection of HPV for *in situ* histochemistry in the mid-1980s, but the arrival of PCR became a game-changer very quickly for the field of molecular diagnostics. My first PCR assay was carried out standing over three water baths held at different temperatures, followed by Southern blotting for hybridisation (an Edinburgh discovery). HPV is one of those viruses which cannot readily be grown in cell culture, so molecular detection was the only way forward. Together with the development of HPV vaccines, PCR has changed our understanding and detection of HPV infection and the diseases/cancers it produces so dramatically that last year the World Health Organization declared that cervical cancer, the most common cancer associated with some types of HPV, could be eliminated. Such is the power of vaccines and screening tests."

Cetus Corporation

It proved a significant career move when Mullis was recruited to the Cetus Corporation biotechnology company in Emeryville, California. The Cetus philosophy was "to eliminate as much of the routine work as possible, to allow scientists the time to do science", but "the safety officer at Cetus and I had a real serious battle... I insisted on keeping my lunch and a case of Beck's beer in the same fridge in which I kept my radioactive isotopes. I kept the beer on the bottom shelf and the radioactive isotopes in a sealed lead-lined container on the top shelf."

Mullis recalls: "Cetus hired me in 1979 to make oligonucleotides. It was a wonderful place to be doing biochemistry... There were all kinds of wild ideas floating around the halls, and there was absolutely no restraint in terms of imagination."

An oligonucleotide is a short chain of nucleotide bases, and in the 1970s, following the discovery of restriction endonucleases – enzymes that snip DNA at specific points – it became easier to isolate sections of DNA containing a gene of interest. "By the late 1970s, molecular biologists were busily studying DNA with endonucleases and with... oligonucleotide probes," Mullis wrote.

Polymerase chain reaction technique

By 1983 the synthesis of oligonucleotides had become automated, and for Mullis "there was a fair amount of time available to think and to putter. I found myself puttering around with oligonucleotides." The focus of Mullis's puttering was to see "if I could arrange for a short synthetic piece of DNA [a primer] to find a particular sequence and then start a process whereby that sequence would reproduce itself over and over" that could then be amplified a billion-fold or more to allow its detection and identification.

One spring evening in 1983 "I was driving to Mendocino County with a chemist friend. She was asleep. US 101 was undemanding. I liked night driving."

"I can't make glowing raccoons appear. I can't buy them from a scientific supply house to study... But I don't deny what happened."

Mullis was mulling, when "Suddenly, I knew how to do it. If I could locate a thousand sequences out of billions with one short piece of DNA, I could use another short piece to narrow the search. This one would be designed to bind to a sequence just down the chain from the first sequence I had found. It would scan over the thousand possibilities out of the first search to find just the one I wanted." Mullis realised that the amplification could be achieved by using a DNA polymerase and that the amplification would be exponential, yielding some billion molecules from around 30 amplification cycles.

"I didn't sleep that night," wrote Mullis. "We got to my cabin and I started drawing little diagrams on every horizontal surface that would take pen, pencil, or crayon, until dawn when, with the aid of a bottle of good Anderson Valley Cabernet, I settled into a perplexed semi-consciousness."

Now Mullis had to prove that PCR worked. The date was 16 December 1983. He chose a 25-base-pair target fragment of a plasmid and two oligonucleotide primers that were 11 and 13 bases long, respectively. "When everything was ready, I ran my favourite kind of experiment: one involving a single test tube and producing a yes or no answer. Would the PCR amplify the DNA sequence I had selected? The answer was yes." Mullis had successfully separated strands of the target DNA by heat; cooled the mixture and annealed primers to the target DNA strand; and used DNA polymerase to amplify with each cycle the target/primer segments of DNA.

Recognition

Mullis wrote up a paper describing his work and submitted it to the journals *Nature* and *Science*. They both rejected it, with *Science* asserting that the paper could "be published in some secondary journal," since it was felt that "it would not be suitable to meet the needs of their

INSIGHTS INTO NEANDERTHAL GENETICS

Terry Brown is Emeritus Professor of Biomolecular Archaeology at the University of Manchester.

"During the 1980s I was one of several people trying to study DNA in archaeological bones. We knew that 'ancient DNA' existed but was present in tiny amounts and very difficult to detect using the methods available at that time. Then in 1986 I read about this new technique called PCR, invented by some guy in California one evening while he was out driving with his girlfriend. It sounded too good to be true – a way of amplifying pieces of DNA from tiny starting amounts into quantities sufficient for sequencing.

"I obtained the necessary equipment and tried it out with a 2000-year-old bone. One week later I had my first ancient DNA sequence. Today ancient DNA is studied by researchers around the world and has given us insights into Neanderthal genetics, the evolution of disease, and the impact of past climate change on ecosystems. None of this would have been possible without Kary Mullis.

readers." But Nobel laureate James Watson – co-discoverer of the structure of DNA – grasped the significance of the PCR technique and invited Mullis to present his work at the 1986 Cold Spring Harbour symposium, the first public announcement of his invention, which was subsequently published in the symposium proceedings.

By 1989, and having previously rejected Mullis' paper in 1986, *Science* conferred PCR with its "molecule of the year" award and chose DNA amplification as the "major scientific development of 1989." PCR automation, with the development of thermal cyclers, has widened the technique's applications, increased efficiency and reduced assay times, and a 2009 review noted: "Forensic laboratory science has been revolutionised by the application of the PCR technique, and PCR has even been used in molecular palaeontology and the study of fossil DNA. Sequencing of the human genome and many animal and microbial species relied on PCR for its success... It can truly be said that Dr Mullis has given an evolving tool that still today continues to yield new and important applications."

But as journalist Daniel S Greenberg explained: "The immense wealth generated by PCR eluded him. The Cetus Corporation, where he worked when he invented the PCR technique, paid him only $10,000 for the patent, which it later sold to Hoffmann-La Roche for $300m."

"Surfer Wins Nobel Prize"

Six months before the 1993 Nobel laureates were to be announced, Mullis' PhD mentor John B Neilands contacted him: "Neilands said that it was probably okay that I admitted loving surfing and women, but he thought the [Nobel] committee might frown on the fact that I admitted using LSD. Surfing, women, and LSD might be too much, he told me."

But early on 13 October 1993 – his mother's birthday – he was given the good news in a telephone call. Then his friend "Steve Judd showed up as he usually did around seven, and I told him that I had just won the Nobel Prize. He said: 'I know. I heard it on the radio. Let's go for a surf'. As it turned out, none of the other Nobel laureates that year were serious about surfing, and 'Surfer Wins Nobel Prize' made headlines."

Mullis won many more awards, achieved a measure of financial security and his status as a Nobel laureate meant that his opinions were sought on a variety of issues. Some of his opinions courted controversy, which Mullis did not shy away from.

Controversialist

In his autobiography *Dancing Naked in the Mind Field* Mullis observed: "The concept that human beings are capable of causing the planet to overheat or lose its ozone seems about as ridiculous as blaming the Magdalenian paintings for the last ice age."

And in November 1994 the organiser of a symposium, Mullis recalls, contacted him to say he was "looking for 'particularly articulate scientists who bridge the biochemical and medical disciplines and routinely engage in out-of-the-box thinking'. Well, that certainly was me." But the invitation was hastily withdrawn when Mullis said: "I would speak about the fact that there is no scientific evidence that HIV is the probable cause of AIDS and that I believed people taking the drug AZT were being poisoned."

On the other hand, 20 years after Mullis aired his views on cholesterol, there seems to be a growing evidence base favouring his statement that "Cholesterol is not some horrible thing that chickens put into their eggs, it's something our bodies need, otherwise we wouldn't be making it. If

there was something wrong with it, our bodies would have learned how to make something else to replace it."

ONE OF THE GREATEST 20TH CENTURY SCIENTIFIC INVENTIONS

Steve Clarke is a retired Fellow of the Institute of Biomedical Science.

"The recent passing of this American biochemist in August this year is an opportunity to reflect on the impact of his conceptual invention of the PCR in 1983. Kary Mullis developed an extreme interest in scientific inventions from an early age. This technique for the rapid amplification of DNA is highly sensitive, specific and inexpensive. It has a vast range of applications in biomedical science, molecular genetics, forensic science and molecular palaeontology and it has been hailed as one of greatest scientific inventions of the 20th century."

IMAGES: REX/AP/SHUTTERSTOCK

Finally

Dr Kary B Mullis had a restless curiosity about many aspects of life, particularly science. He continued to be active, vocal and causing controversy until the end of his years. That his powerful, playful intellect generated not only one of the twentieth century's great scientific advances, but also courted controversy, invites the inference that progress is not so much dependent on what we think but on how we think.

The Nobel Prize-winning chemist, and surfer, wrote: "When I fall, I hold my breath. The sea takes me into her arms. I'm not bruised. I wait underwater until the action of my board in the whitewater, bouncing around, looking to all the world like it was trying to find my head, is over. Then, I come up." BMS

To view the article with full references, visit the website thebiomedicalscientist.net

KARY B MULLIS IN QUOTES

The safety officer at Cetus and I had a real serious battle... I insisted on keeping my lunch and a case of Beck's beer in the same fridge in which I kept my radioactive isotopes.

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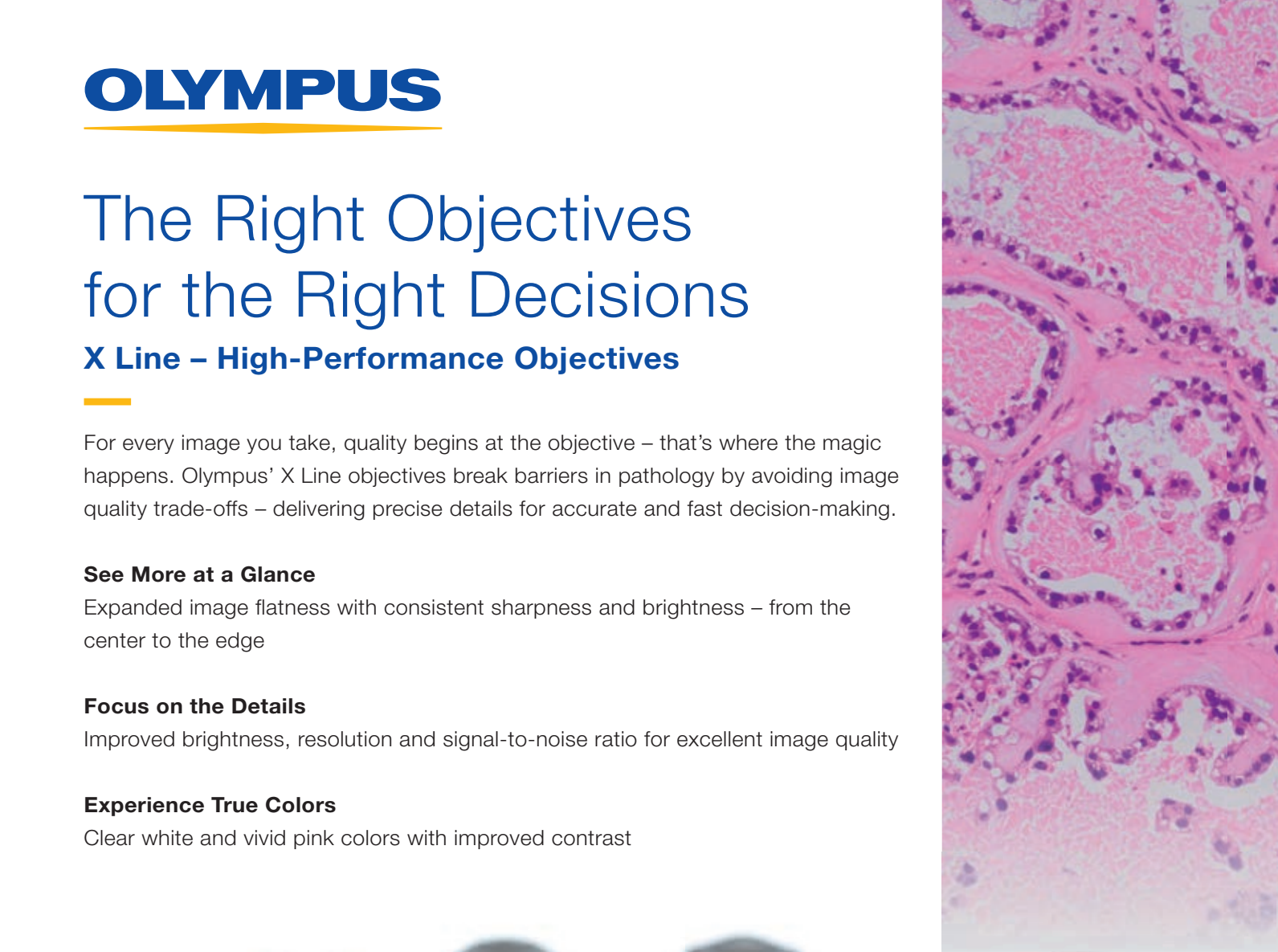

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IBMS CONGRESS 2019 ROUND-UP

Sarah May, the IBMS Deputy Chief Executive, looks back on another successful Congress and picks out some of her highlights.

Wow, didn't we have a ball! After almost two years of preparation and build-up, Congress has just ended and my months of worry were proved to be unfounded. More people, more talks, lectures and more exhibitors; speaking personally, Congress was everything I hoped it would be and more. If you weren't able to come, make sure you don't miss out in 2021.

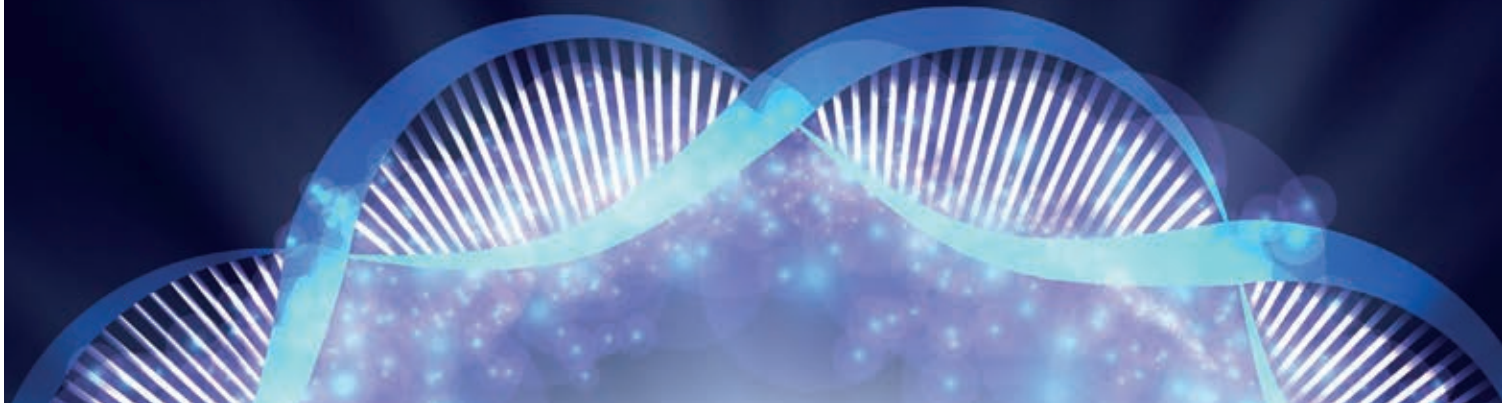
I know I have written and talked extensively about the Congress lecture programme, but the thing that really gave Congress its "buzz" was the exhibition; there is nothing like it in any other pathology or life science event. The effort our industry partners put in to Congress is remarkable and it is what makes Congress different; it was an integral part of the whole event. I would like to thank our Company Members and other exhibitors who worked so hard with us to make Congress such a success; in particular I would like to thank Mark Reed of ProLab, who is the Chairman of our Company Members and a vital link between the Institute and our industry colleagues. Congress would not be the success that it is without the input of our industry partners.

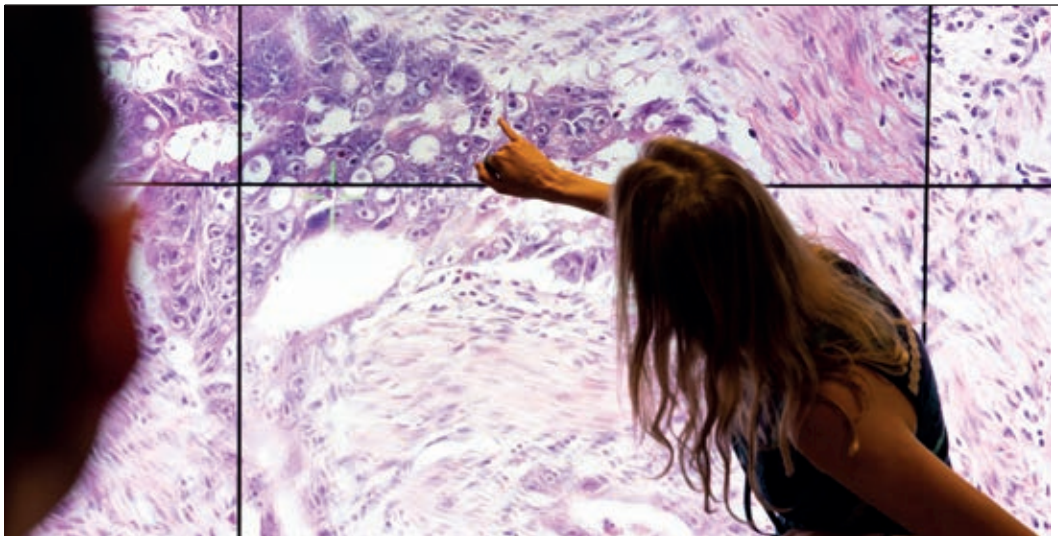
For the past few Congresses we have been running seminars in the Hall 4 exhibition, but this was the first year we decided to run a full programme to parallel that of the main lecture programme. I know it is challenging putting seminars in an exhibition hall, but I felt the strength of the programme and the presenters more than compensated for "acoustic challenges". At this point I would like to thank Jocelyn Pryce and Chris Ward, who talked themselves hoarse with their education and training presentations and their almost permanent availability to answer questions from delegates about our examinations. I suspect they will need the next two years to recover!

The thing that really gave Congress its "buzz" was the exhibition; there is nothing like it in any other pathology or life science event

What delegates probably didn't notice was that we used Congress as an opportunity to record a number of podcasts to extend learning opportunities to our members after Congress has ended. More information about these will appear in *The Biomedical Scientist*, but we have captured some valuable interviews with key lecturers that will shortly be available to view via our website.

Finally, the best bits for me were the brilliant, Prof Sophie Scott who delivered the Opening Plenary presentation on The Science of Laughter (I'll know exactly what is going on in my head next time I'm having a jolly good laugh) and the Closing Plenary speaker, Dr James Grieve, who managed to convey more bristling enthusiasm about a post-mortem than I had ever thought was possible. Suggestions for Congress 2021 topics to me on a postcard, please. IBMS





IMPLEMENTING DIGITAL PATHOLOGY

Following her plenary session at IBMS Congress 2019 on "Total digital pathology", Chloe Knowles looks at the lessons learned from her laboratory's transition to scanning slides.

Leeds Teaching Hospitals has been scanning 100% of its surgical slides for over a year. In that time, around 280,000 slides have been scanned, over 20 lab staff trained, and created 330Tb of data. We have gained ISO15189 accreditation for digital pathology for primary diagnosis, and continue to scan 1000 slides a day.

Deploying digital pathology is an exciting challenge for a laboratory, and there are many aspects to consider to have a successful deployment. Here we look at the lessons that have been learned at Leeds Teaching Hospitals, through implementing digital pathology into the laboratory.

01 Stakeholder engagement

Involving all staff in the department is vital; from lab staff and management, to local IT. The communication given has to be relevant, specific and regular to ensure everyone remains engaged. At Leeds there was varying opinion of how digital pathology would impact the lab. We distributed a survey to gauge knowledge and experience of digital pathology. Using the responses, we delivered presentations to ensure everyone was on the same page.

02 Workflow

Implementing digital pathology is a great way to review your laboratory process, from specimen reception through to reporting. Leeds used Lean principles to assess the workflow and evaluate how digital pathology would be incorporated. It is important that digital pathology is not considered as an additional step when planning your digital workflow.

03 Scanner location

Where to put the scanners is crucial; it reinforces that the digitisation of the glass slides is the final step in the laboratory process. At Leeds, we conducted a formal options appraisal of 10 locations. We assessed criteria such as walking time, hands-on time and any

existing infrastructure. We chose a bench along the back wall, adjacent to all the microtomy stations. This kept digital pathology centralised and visible for all.

04 Slide preparation and scanning

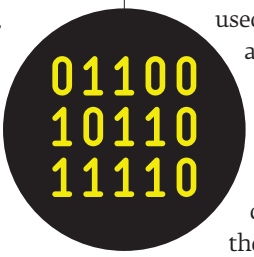
Biomedical scientists and support workers know what constitutes good slide preparation, and the same principles apply when preparing slides for scanning. Tissue sections should be thin and placed in the centre of the slide. There should be no broken or overhanging coverslips, and no excess mountant around the edges of the slide. These steps maintain the lifespan of the scanners and avoid unnecessary delays. It is also important that there is no dirt or excess wax on the slides, which will cause the images to be out of focus. All slides at Leeds are checked and cleaned if necessary during the quality control procedure before being sent to the scanner.

05 ISO15189

Gaining and maintaining ISO15189 accreditation for any laboratory test is important, and digital pathology for digital diagnosis is no different. The laboratory needs to demonstrate to assessors that the process is safe for patients and staff. There are several things to consider when collating evidence to submit for accreditation.

Seeking accreditation

Change control- Digital pathology was a new process for Leeds, with new equipment and new skills, which needs to be managed appropriately. Following a change control procedure ensures that the correct people are identified, and the appropriate paperwork is completed to ensure a successful deployment.



Risk assessments- These are a core aspect of implementing any new process into the laboratory. There were four types of risk assessment completed at Leeds General:

- The location of digital scanning equipment and workflow
- Equipment identified/potential risks with moving parts of the equipment
- Process made sure the workflow was safe for patients and staff
- Display screen equipment for all users, even if they had completed one previously.

Validation and verification- Laboratories must provide evidence to assessors that they have proved that the equipment aligns with the performance that the manufacturer states. In terms of digital pathology, this can include: scan time, internal and external components of the scanner perform correctly, and uncertainty of measurement. The validation and verification must be a written document, including results and outcomes of internal testing. A way of completing this for digital pathology is to perform tests against the initial manufacturer's installation checklist.

Comparability and reproducibility- Leeds currently has nine digital pathology scanners, and their performance needs to be monitored. The images produced need to be consistent across all scanners.

Inter-laboratory schemes are traditionally used to demonstrate comparability and reproducibility, but as digital pathology is in its infancy for primary diagnosis, this may be difficult to achieve. Internal methods can be used to demonstrate this, by scanning the same batch of slides on each scanner for a pathologist to review the quality of the images.

Training and competence- In order to keep the process consistent and controlled, standard operating procedures (SOPs) need to be available for staff. The tasks outlined in the SOPs need to be reflected in training and competence documentation to demonstrate that staff are able to carry out specific tasks efficiently. These records also need to be continuously updated in line with any changes to SOPs or goals that were set during the previous round of training.

Preparation for ISO15189 accreditation requires a lot of hard work and dedication from the laboratory. At Leeds there were 14 people involved with the accreditation process, with a total of 62 documents submitted as evidence. The team worked tirelessly to make it possible, with approximately 6000 hours of total time spent. This resulted in only seven findings, and one accreditation of digital pathology for primary diagnosis.

Leeds continues to build on its digital pathology service, looking at ways we can improve the patient pathway, in a time where we are seeing pressure in terms of turnaround times and staff retention. In the future, Leeds is hoping to utilise the benefits of digital pathology across the West Yorkshire region to aid faster second opinions and referrals, meaning patients will have less time to wait in an already unsettled time in their lives. BMS

Chloe Knowles is a Specialist Biomedical Scientist and Lead for Digital Pathology at Leeds Teaching Hospitals NHS Trust

DIGITAL PATHOLOGY AT LEEDS IN NUMBERS

330Tb
More than 330Tb of data have been created since the project started in 2017

20
Over 20 lab staff have now been trained to use digital slides

6000
There were approximately 6000 hours of work completed to secure accreditation of digital pathology for primary diagnosis

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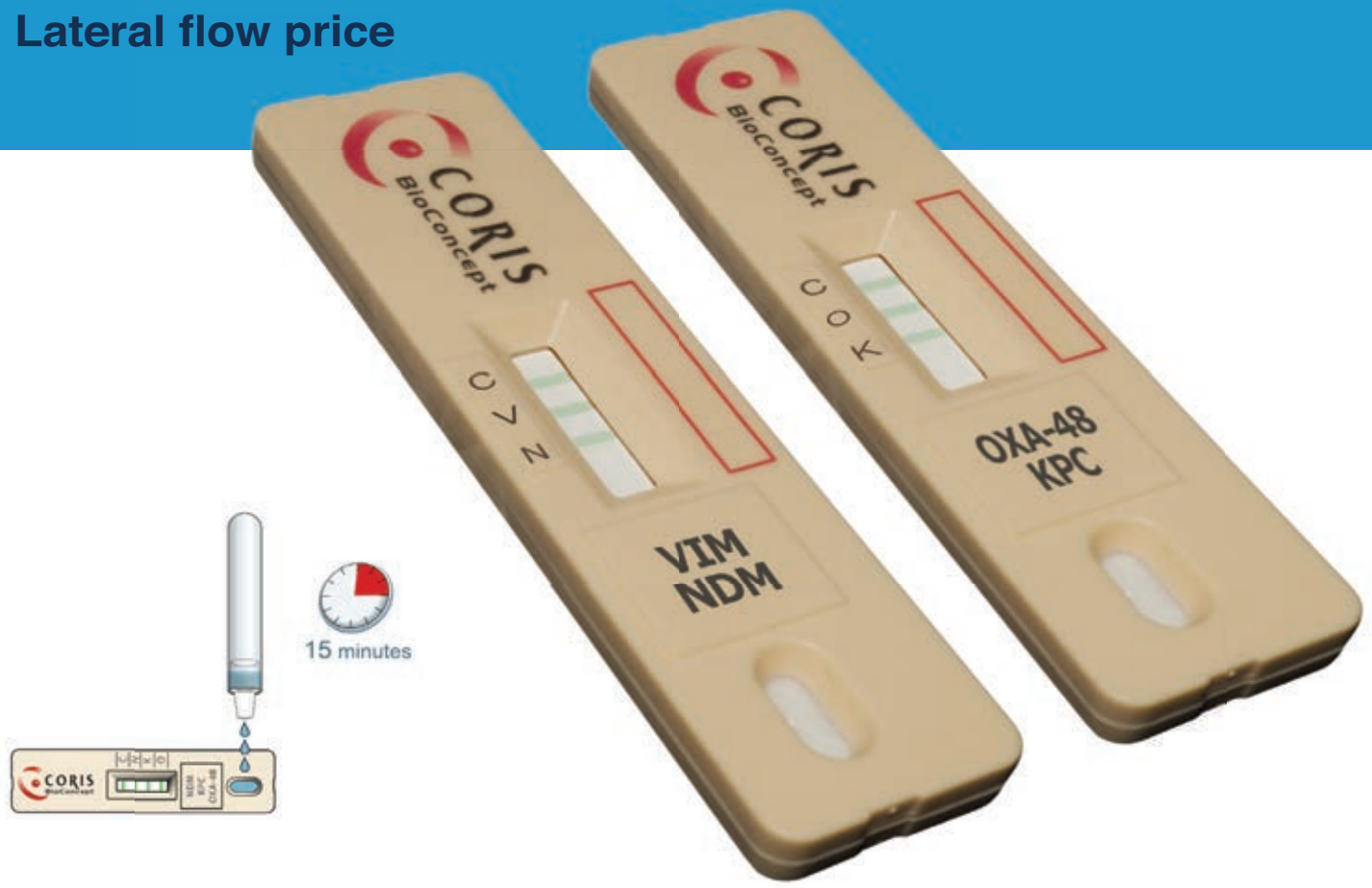
PCR performance
Lateral flow price



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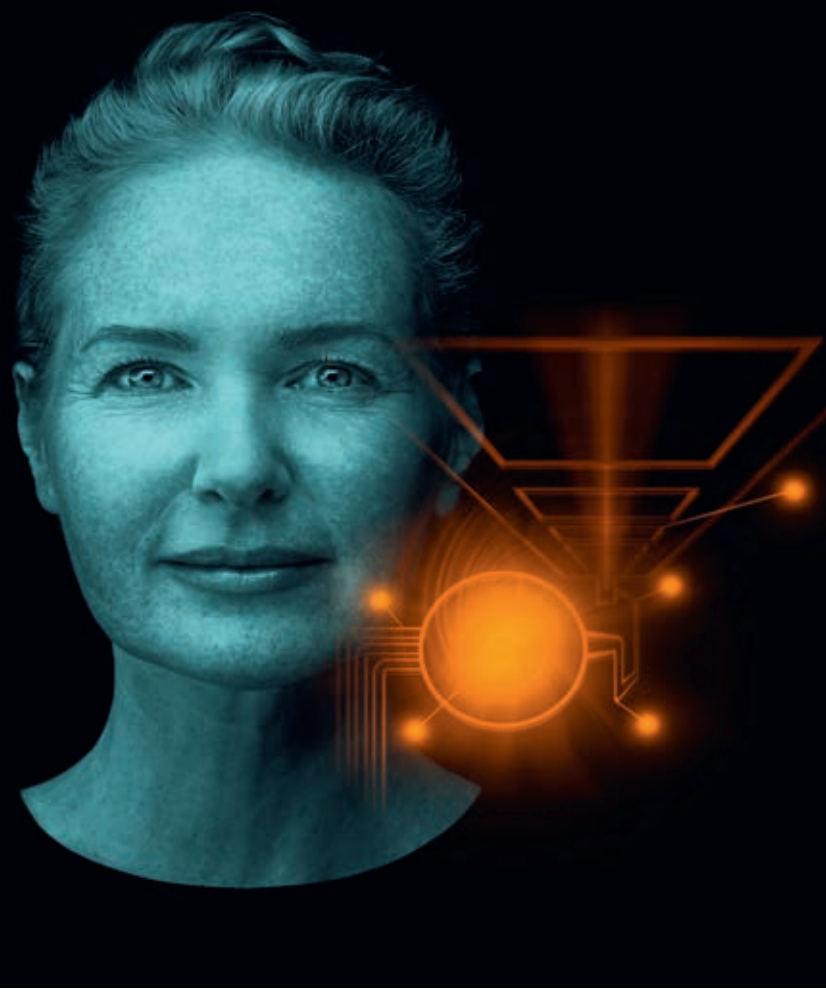

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THE IBMS BIOPOD

Over the coming months, the IBMS is due to launch it's own podcast – the IBMS Biopod.

Podcasts are free audio programmes distributed over the internet, which you can stream or download. Any internet-connected computer can play podcasts, although they are most easily listened to on mobile devices.

The upcoming IBMS podcast will have a different theme for each instalment, including upcoming episodes based around point-of-care testing, education, accreditation and quality, haematology and chemistry, microbiology and virology and cellular pathology and cytopathology.

Each episode will feature experts from the field discussing their research and talking about the latest developments.

With self-directed learning becoming increasingly important for staying up to date with the latest research and news and developing knowledge for the wide range of IBMS exams, the podcast is hoped to be a valuable learning and CPD resource for members.

For those who can't wait for the launch the IBMS Biopod, to the right is a column of some other science and health podcasts recommendations.

Podcasts can often be accessed through podcast apps available on smartphones and tablets. The IBMS Biopod will be available from the IBMS website.

RECOMMENDED LISTENING

The BMJ Podcast
This aims to provide up-to-date interviews and debate with opinion leaders from health and medicine. The journal also has the *BMJ Best Practice Podcast*.

The Life Scientific
A BBC Radio 4 science programme, presented by Professor Jim Al-Khalili, in which each episode is dedicated to the biography and work of one living scientist.

Everything Hertz
A podcast by scientists, for scientists. Featuring methodology, scientific life, and some bad language. Episode 28 – "Positive developments in Biomedical Science" will be of particular interest.

The Bio Report
A US podcast hosted by award-winning journalist Daniel Levine, which focuses on the intersection of biotechnology with business, science, and policy.

Nature Podcast
Features highlighted content from the week's edition of *Nature*. This includes interviews with and commentary from the people behind the science.

Q&A

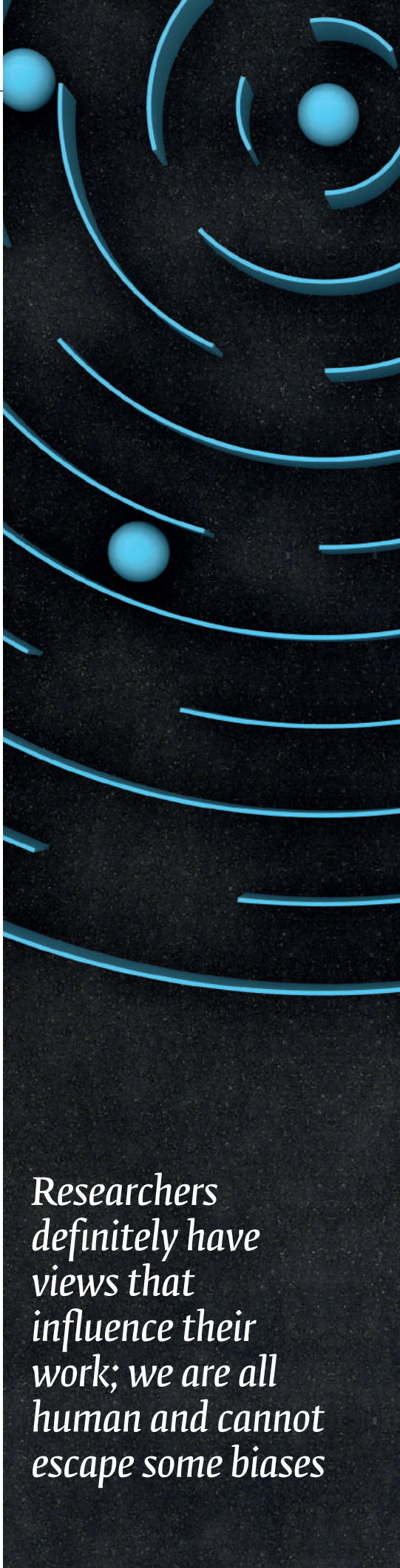
THE IMPORTANCE OF FAILURE

Leslie McIntosh, co-author of a new report into improving scientific research, answers questions on reproducibility, falsifiability and methods.

Q What is good research?
This is a complex question. We must look at (and separate) the research from the communication of that research, as "good research" will be defined differently for each. While defining good practices varies across scientific disciplines, there are common best practices needed across all disciplines. In biomedical sciences, this means capturing a significant amount of ancillary information to the research process. For example, best practices would include having the entire compendium of scientific research documented and reproducible. This will include ensuring clearly articulating the research objective, citing your data sources, and sharing code. But not all things (e.g. private data) can be openly shared. So good research should be a commitment towards transparency, even when accessibility of all pieces is not possible.

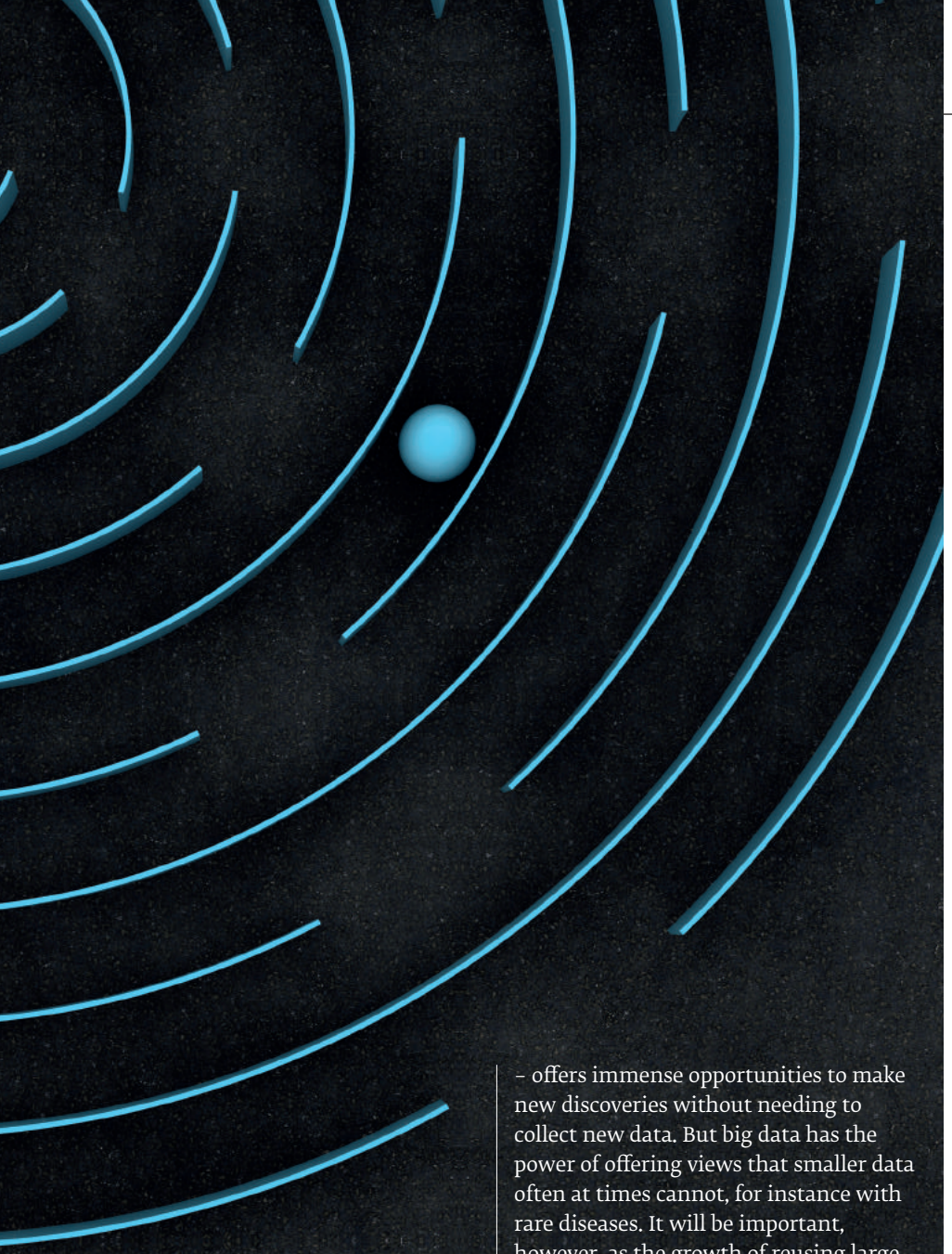
Q How much current published research would you say is good research?
There is good research represented across scientific journals and globally, yet, almost all published research could be improved. It is frustrating to read what appears to be good science, yet the publication lacks a robust methods section to back up the work. As mentioned in the *Making Science Better* report, if we start from a simple construct of what good research is then it starts with a well-defined study objective or hypothesis. While I believe most researchers have a hypothesis, those are not clearly stated in the publications.

Q Do many researchers consciously or unconsciously skew their results in search of the conclusions they want?
Researchers definitely have views that influence their work; we are all human and cannot escape some biases that may unconsciously skew results. However, these views differ by research. And as science is a collective endeavour by individual actors, any skewing that may occur could be accounted for. There is certainly evidence some researchers consciously skew results through such means as p-hacking (i.e. inflation bias), which is analysing resulting data until one finds something significant.



Researchers definitely have views that influence their work; we are all human and cannot escape some biases

IMAGES: ISTOCK



REPORT SYNOPSIS

Making Science Better: Reproducibility, Falsifiability and the Scientific Method looks at the current state of reproducibility in 2019, as well as the importance of falsifiability in the research process.

The analysis comes from the Digital Science portfolio company, Ripeta, which hopes to make better science easier by identifying and highlighting the important parts of research that should be transparently presented in a manuscript and other materials.

The report addresses three main topics: appropriate documentation and sharing of research data, clear analysis and processes, and the sharing of code.

For more information and to read the report, visit digital-science.com

Q Your report says reproducibility is very important - why is this?
Ultimately, having reproducible research builds (or weakens) the trust in the scientific work. Reproducibility lies at the heart of the scientific method. This method depends on the verifiability and reproducibility of findings crucial to the construction of a scientific heritage. This allows the construction and validation of findings from others' work.

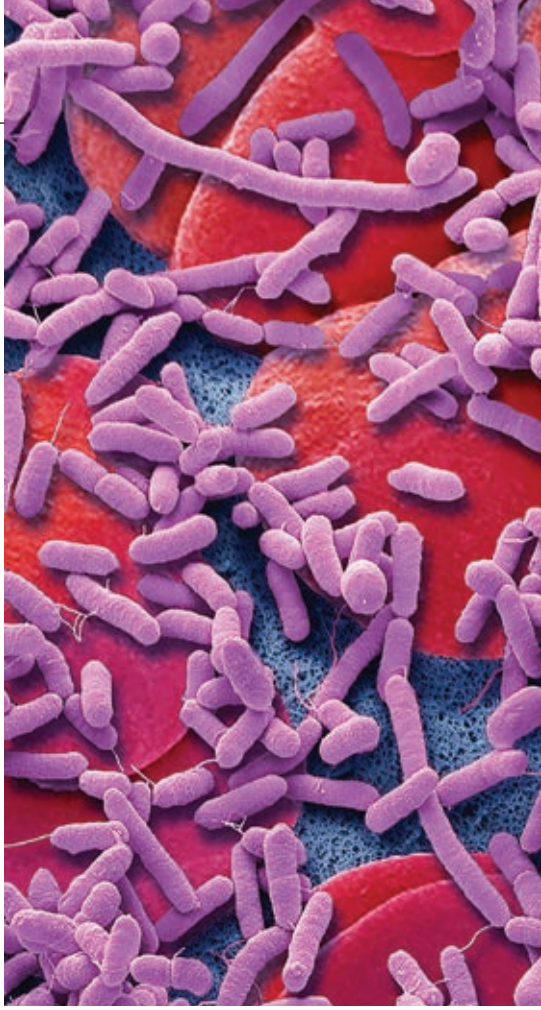
Q Is big data and data access (for example, that produced by Genomics England) going to have much of an impact on research?
Both big and small data will definitely have an impact on research. Having available data – particularly data that are well documented for better understanding – offers immense opportunities to make new discoveries without needing to collect new data. But big data has the power of offering views that smaller data often at times cannot, for instance with rare diseases. It will be important, however, as the growth of reusing large datasets continues, that transparent research processes are communicated. This will help to highlight assumptions that can then be tested and challenged.

Q Should all registered research be published?
From my perspective, all research should have transparent processes available even if all research results are not published.

Q Why is failure something that is increasingly important in modern research?
Failure has always been important in research; success is built off of failure. Yet, science is more complex than ever before due to many advancements (e.g. computational capabilities) thus obscuring the true causes of success or failures. It has been easy to assume that we truly test what we think we are testing (e.g. a new drug), when in actuality there is a nuance of a computer programme influencing the calculations. Additionally, failing in the process of conducting research is different than having an experiment fail (e.g. not support the hypothesis).

Q What is the one key message you would like people to take away from your report?
To make science better, we need to make better science easier. Better science is reproducible and falsifiable. Making science easier means embedding good practices and checks for good science into our scientific ecosystem. BMS

Dr Leslie McIntosh is one of the lead authors of the *Making Science Better: Reproducibility, Falsifiability and the Scientific Method* report. She is a consultant, speaker, and researcher passionate about mentoring the next generation of data scientists.



SEPSIS AND ANTIBIOTICS

The ADAPT-Sepsis Trial Coordinating team explains how NHS biochemistry teams are leading in the fight against antibiotic resistance.

Antibiotic resistance is a global concern and as a result the NHS and health organisations across the world are trying to reduce their use. Antibiotic use is a rich area for research and one trial looking into this area is ADAPT-Sepsis – a biomarker-guided trial in hospitalised patients with suspected sepsis seeking to reduce antibiotic duration. Laboratory biochemistry teams across the NHS, led by biochemical scientists, are integral to the delivery of this innovative trial.

The ADAPT-Sepsis trial aims to protect the effectiveness of currently available antibiotics for the whole UK population and develop treatment strategies that will prolong the effectiveness of new antimicrobial pharmaceuticals as they emerge. The trial is exploring whether treatment protocols based on serial monitoring of C-reactive protein (CRP) or procalcitonin (PCT) safely allow reduction in duration of antibiotic therapy in hospitalised patients with sepsis.

This is the first large-scale comparative study of CRP and PCT in this field and the first ever to include a blinding strategy to provide the highest quality evidence for these biomarkers during routine NHS care. This would not be possible without the input of NHS laboratory biochemistry teams across the UK.

A prolific killer

Sepsis results from overwhelming reactions to microbial infections where the immune system initiates dysregulated responses that can lead to remote organ dysfunction, shock and ultimately death. Sepsis is a prolific killer with a death occurring every 3.5 seconds globally. While immediate, appropriate antibiotic treatment for sepsis will help save lives, the current recommended duration of antibiotic therapy for sepsis is very uncertain and is based on low-quality evidence that may lead to antibiotic overuse, contributing to the development of antimicrobial resistance, a national and global priority.

CRP and PCT are circulating plasma proteins that are often raised in sepsis and usually fall in response to effective antibiotic treatment. They are readily measurable in NHS laboratories using standard equipment, providing a potential opportunity to personalise antibiotic duration, which could lead to reductions in population antibiotic usage, adverse effects for patients, improved healthcare resource utilisation and downstream effects relating to antimicrobial resistance.

The ADAPT-Sepsis trial will provide valuable insight into the treatment of sepsis and is also unique in its design, with the role of NHS laboratory biochemistry essential to ensuring high-quality assay performance and that

ADAPT-SEPSIS TRIAL TEAM

Chief Investigator: Professor Paul Dark, Chair of Critical Care Medicine and Honorary NHS Consultant in Critical Care Medicine

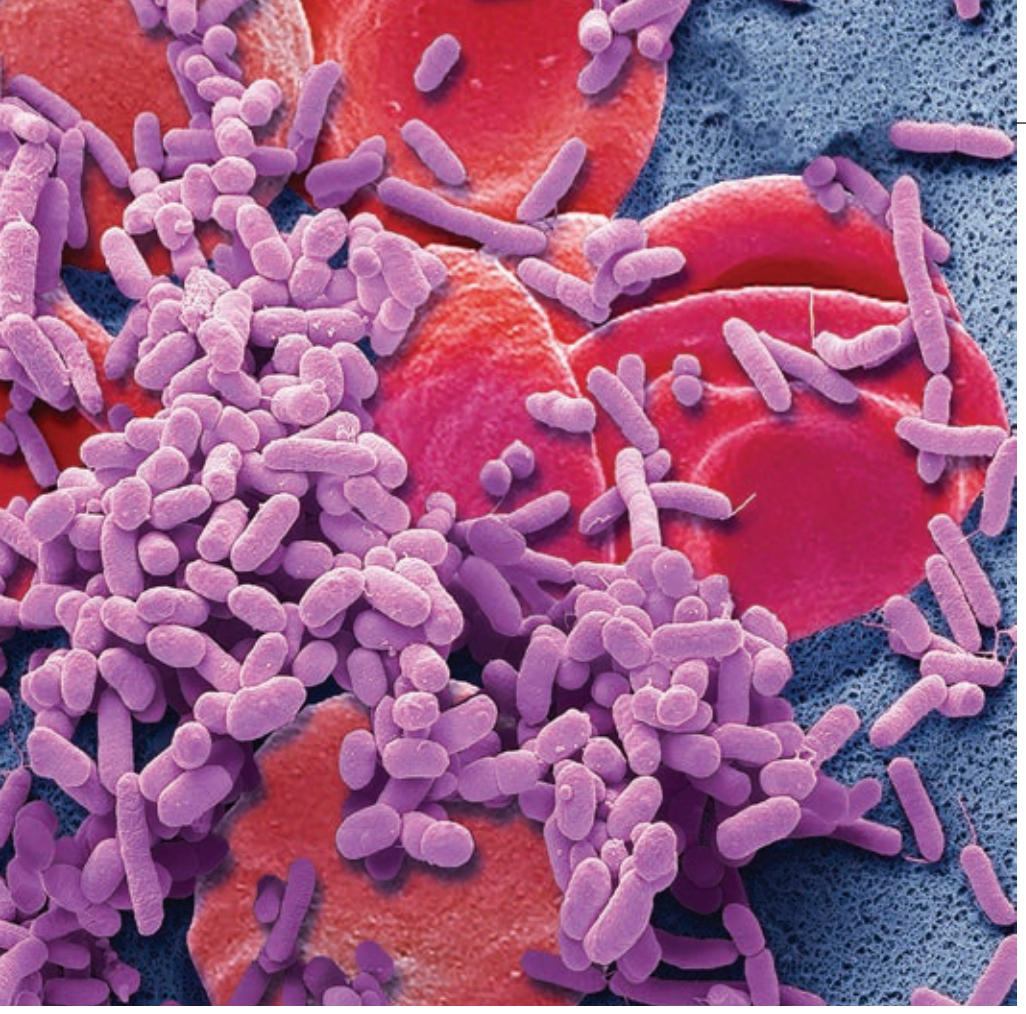
Senior Project Manager: Scott Regan

Trial Manager: Nicola McGowan

Trial Coordinators: Johnny Guck, Maddy Flawn & Uzma Manazar

Administrator: Dharmesh Patel

Data Clerk: Belinder Ghuman



IMAGES: SCIENCE PHOTO LIBRARY/ISTOCK/SHUTTERSTOCK

the trial interventions can be followed successfully. After recruitment to the study, patients are randomised to one of either two treatment protocols in addition to standard care:
(a) Standard care
(b) Standard care + daily CRP monitoring
(c) Standard care + daily PCT monitoring.
ADAPT-Sepsis is a double-blinded trial, so the patient, site research team, treating clinical team and the trial coordinating team will not know which treatment allocation a patient receives. Only the biochemistry teams who perform the required biomarker test will know the treatment allocation.

Essential cog

Daily blood samples, from trial participants receiving antibiotics, are sent to laboratory biochemistry teams who perform the required assay and feedback results to the trial database. Antibiotic treatment advice for that patient for that day is automatically generated and sent to the treatment team (either supporting usual care or issuing two levels of antibiotic stoppage advice). This treatment advice is considered by the treating clinical team alongside other routine assessments to assist the clinical decision making process. Biochemistry teams are at the forefront of facilitating this essential trial process, which directly impacts upon patient care.

This study is a collaborative effort, with NHS clinical laboratory biochemistry teams as an essential cog in the wheel to deliver trial success for patients. Recognising that biochemistry departments are already under pressure to deliver routine practice, the trial has been designed to ensure it is implementable within an NHS laboratory setting. Jonathan Clayton, trial co-investigator and Senior Clinical Scientist at Salford Royal Hospital, has helped shape the study from its inception and has allowed the development of study processes, which are workable and achievable within real NHS labs. Trial education requirements are pragmatic and streamlined to enable training of large biomedical scientist bodies and the study online database has been designed to take just a few seconds to navigate.

Sepsis is a prolific killer with a death occurring every 3.5 seconds globally.

Delivering important research

The study is currently recruiting at 20 centres and continues to open additional sites. NHS laboratory biochemistry teams are involved in early site set-up discussions alongside the research and clinical care delivery teams to ensure each individual centre is able to deliver the study protocol. The trial team has developed bespoke solutions to overcome local barriers and existing lab leads, recognising the importance of this trial, has championed ADAPT-Sepsis and encouraged set up in neighbouring sites.

Whilst CRP is routinely used within the NHS, PCT remains a niche assay. The ADAPT-Sepsis team has helped the majority of participating centres to implement the PCT assay. These sites are now gaining experience of using the assay and the trial aims to contribute to a growing evidence base on PCT use in guiding antibiotic discontinuation.

The trial team would like to thank existing centres for their much-appreciated efforts to deliver this important research and to recognise the enthusiasm from the NHS laboratory biochemistry community as a whole. BMS

Any centres interested in taking part in ADAPT-Sepsis (ISRCTN47473244) are encouraged to get in touch.
Email: adaptsepsistrial@warwick.ac.uk
Telephone: +44 (0)2476 151386

THE ART OF SCIENCE

Here is a selection of agar art submitted in the latest IBMS online competition.

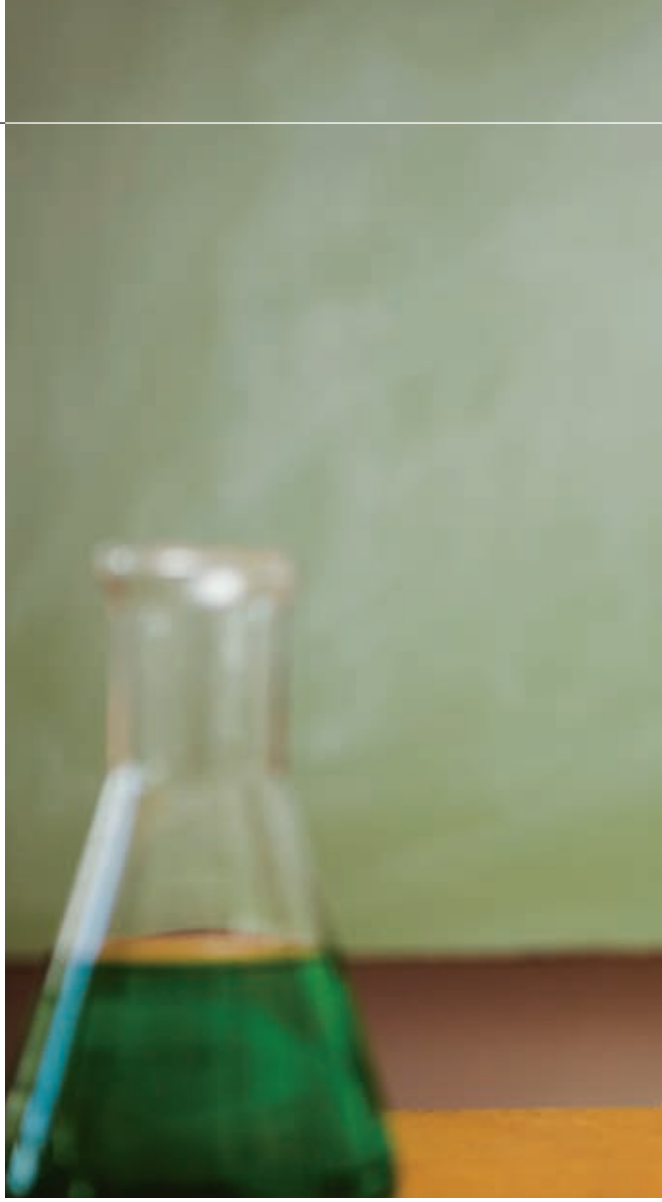
Every month, the IBMS runs an online competition, prompting members to pit themselves against the rest of the profession in order to win the best in "I love biomedical science" prizes.

Photos can be submitted via Facebook or Twitter by posting in the competition threads or using the #IBMSCompetition hashtag. Submissions are also accepted via website@ibms.org.

The theme for October's competition is "spooky science". Send the IBMS your best pictures and get your friends to like them in our Facebook gallery to scare off the competition.

Please visit our website for more information on monthly competitions for members, including rules, prizes and how to take part. To view past competition entries, visit our Facebook page gallery at facebook.com/biomedicalscience

If you have ideas for future photo competitions, email communications@ibms.org



HOW TO... GET CHILDREN INTERESTED IN BIOMEDICAL SCIENCE

Matt Wilven, Communications Officer at the IBMS, gives practical tips and guidance on how to engage with youngsters.

BACK GARDEN CHEMISTRY 101:

Apparatus:
- Two large empty plastic bowls
- A large floor sheet (to catch the mess)

Ingredients:
- Water
- Old batter mix
- Old spices
- Old bits of grain
- Baking soda
- Measure of vinegar

Method:
- Add one or more child
- Set expectations as to where the rubbish can go and will end up
- Issue subtle but irresistible warning not to mix water, baking soda and vinegar in the same bowl
- Leave UNSUPERVISED

The quick recipe on the left is for a young child to have an enjoyable scientific experience because, when you really boil it down, science is about curiosity and experimentation. If a child can get a taste for the joy of those two aspects early on, then they will be better placed to love science later. Don't stand over their shoulder comparing vinegar with a disease and baking soda with the immune system unless it seems to be part of a conversation they want to understand. It is usually best to avoid presenting concepts like "science" or "learning" until the fun has been had.

It's important to remember that biomedical science does not have to be technical or serious, it can be fun too. The trick is to make a child curious enough to ask questions and stay interested long enough to figure out the answers for themselves. The words "biomedical science" sound like hard work to a child, but a well-framed question at the breakfast table can lead to a conversation full of biomedical science facts and knowledge: "What do you think happens when you put the wrong type of blood in someone?" "Did you know that your breakfast cereal is magnetic?" "What colour do you think blood is if you take out all the red bits?"

Once they get to Key Stage 2 and you have engaged their interest, you can start making more time for conversation and analysis in and around your activities. Baking is a good place to start. It involves measurements, maths, reading, following instructions, practical skills and chemical reactions – and it's incentivised with a yummy treat. Let your child choose what they want to make from a cookbook.

""What do you think happens when you put the wrong type of blood in someone?" "Did you know that your breakfast cereal is magnetic?"

Guide them around the shop so that they can pick up their ingredients. Besides handling the oven, give them complete ownership of the process. If you can help a child to experience enquiry and discovery – things they associate with play – then you can begin to help them build on their natural curiosity and turn it into a lifelong skill.

Whatever activity you set up, try not to praise the child's ability or intelligence too much. Praising their process is a more effective tactic if you want to embed the potential for a passion for biomedical science. This means praise for their hard work, their strategies, their focus, their perseverance, their use of errors to learn, and their improvement – the sorts of skills you would be happy to see in a colleague. As they make decisions, ask them what they are doing and why. Studies suggest that most children become more intelligent problem-solvers when they are taught to test hypotheses and explain their own reasoning.

As children grow and become more outward looking, they inevitably come into contact with illness, disease and death, and it is important for them to know that biomedical scientists are working in hospital laboratories to help keep everybody safe and well. Help them understand that biomedical scientists and laboratory staff are a major part of the healthcare service, and that biomedical science is behind the diagnosis, prevention and control of infection and disease. If you foresee eyes rolling into the back of heads, IBMS members can ask us (communications@ibms.org) for a copy of our *Superlab* comic, which uses fun characters and puzzles to teach and impart these lessons.

If you're interested in getting children involved in activities that reach beyond generic skillsets and more deeply into biomedical science as a subject, our members have helped us to develop some new activity sheets for children. Each sheet represents a 10-20 minute activity which introduces and puts into practice an aspect of biomedical science ("magnetic cereal", "centrifugal force", "blood grouping" etc). They outline the things you will need, what aspects of the science to explain and how to put the experiments in motion.

These new resources are available to download on the following webpage: ibms.org/activities

Whether dealing with your own children, visiting a school or a children's ward, remember that these techniques are great outlines to engage children with biomedical science, but nobody is the perfect parent or teacher. Just like in science, outcomes will be different to expectations, and sometimes disappointing. Children are not always in the mood to learn or behave – and the dreams of perfect cohesion projected in articles like these can fall to dust. But don't despair. Biomedical science is a noble calling and just telling children who you are and what you do will be enough to impart the knowledge that scientists are out there in their communities helping people through their healthcare journeys. IBMS

NATIONAL PATHOLOGY WEEK:

Pathology Week, which takes place on 4 to 10 November, is a great time to set up stands in hospital lobbies or visit schools and children's wards to inform young people about biomedical science.
To enhance public engagement events, members can order boxes of promotional items from the resources section of the IBMS website (you can choose your items, including the *Superlab* comic). If you want to make your event or stand more fun and interactive have a look at IBMS activities page (ibms.org/activities).

MY IBMS NEWS

PROFESSIONAL PROMOTION

NATIONAL PATHOLOGY WEEK

It's time to make big (and small) plans for this year's National Pathology Week.

The Royal College of Pathologists' annual week-long celebration of pathology, and the important contribution pathologists make to healthcare, runs from November 4 to 10.

This year's theme is "Exploring Innovations Big and Small" and The Royal College would love to see public events around current research.

"New advances in pathology, such as digital pathology and genomics, can be exciting themes to highlight," they said.

"We're also encouraging wider interpretations around the 'theme' of innovation that highlight more everyday breakthroughs and small 'acts of genius' in pathology."

These might include new ways of working, or smart initiatives in pathology teams that have helped make a difference to the health of patients or have contributed positive to the work of other healthcare professionals.

Another option is to encourage laboratories to open their doors to fellow staff members and welcome them to tour the labs to help them learn how biomedical science is at the heart of healthcare.

Last year Rehana Ayub and her colleagues from the immunology department at Leeds Teaching Hospital hosted an open day for visitors, including local students.

"This was a great informative experience for the students to learn the steps they can take to become a biomedical scientist," she said.

→ **For more details, visit bit.ly/2lCmStX**

PROFESSIONAL REGISTRATION

HCPC registration renewals due

It's time to renew your registration for the Health and Care Professions Council.

The deadline for the renewal period for biomedical scientists is November. Those renewing their professional registration are required to declare that they have continued to meet the HCPC's standards of practice, including Continuous Professional Development (CPD).

The CPD is the record of activities that HCPC registrants keep to demonstrate their learning and development throughout their careers – showing that their skills and knowledge are current and that they continually demonstrate good professional practice.

Your online account allows you to renew your registration and pay your registration fee securely while you can also renew via a paper renewal form.

→ **For more information, visit bit.ly/2m2PX1O**

IBMS JOURNAL

CALL FOR PAPERS FOR THE JOURNAL

The January issue of the *British Journal of Biomedical Science* will contain two case reports, both of which will have multidisciplinary aspects.

Editor Andrew Blann will now be seeking informative case report for potential publication.

To qualify, the case must teach us something new and must be relevant to at least three disciplines.

The format will roughly cover an "In Brief", but with an abstract, with a wordcount of up to 2000 and up to 15 references. Instructions to author will be on the website soon.

BIMOLECULAR RESEARCH

Slime of the times

IBMS fellow Dr Sarah Pitt has made the headlines, using her IBMS research grant to identify the antibacterial properties of snail slime.

The Principal Lecturer at the School of Pharmacy and Biomolecular Sciences, Univeristy of Brighton, hit the news after her announcing her breakthrough in the search for new antibiotics.

She identified antibacterial properties in snail slime which could be used to treat burn wounds and lung infections.

Her research was made possible through her successful application for an IBMS research grant.

→To read the original article, published in the *British Journal of Biomedical Science*, visit bit.ly/2m7vj0F.

INNOVATION

OUR FAB FIVE

Congratulations are in order to the quintet of trailblazing IBMS members who have made *The Pathologist's* prestigious Power List.

The theme of this year's list is "trailblazers of the laboratory" and the five winners have been honoured as 100 of the leading innovators in pathology and laboratory medicine who are at the cutting edge of their field. The fab five are:

- **Bamidele Farinre** – Senior Executive Officer of the Clinical Services Unit, National Infection Service, for Public Health England. Nominated for her dedication to encouraging women and minorities into STEM subjects. She works with numerous organisations to achieve this goal.

- **Joanne Horne** – recently crowned Biomedical Scientist of the Year for 2019. "Joanne continues to trailblaze in GI histopathology, changing the face of modern medicine reporting and ensuring that low consultant numbers don't increase cancer waiting times to diagnosis."

- **Alison McEvoy** – Haematology Laboratory Operational Manager at Milton Keynes University Hospital NHS Foundation Trust. Alison has been described as "A brilliant leader who always has the needs of her team in mind and involves them in decision-making, something that is reflected in the laboratory's continually improved outcomes."

- **Malcolm Robinson** – biomedical scientist from Western Sussex NHS Hospitals Foundation Trust. Founded a charity called Harvey's Gang, which gives children across the UK laboratory tours to show them the journey their blood samples take. Won Biomedical Scientist of the Year 2018.

- **David Wells** – Head of Pathology Services Consolidation at NHS England and NHS Improvement. "Drives the type of unprecedented change in UK pathology that has attracted global attention, especially due to his excellent work with networking and consolidation."

JOURNAL-BASED LEARNING EXERCISES

Please select your choice of correct answers and complete the exercises online at: **www.ibms.org/cpd/jbl**

DEADLINE WEDNESDAY 8 JANUARY 2020

The rivaroxaban-adjusted normalized ratio: use of the prothrombin time to monitor the therapeutic effect of rivaroxaban

Kim B, Jang S, Lee YJ, Park N, Cho YU, Park CJ. *Br J Biomed Sci* 2019; **76** (3): 122–8.
Assessment No: BJBS1019A

01	Anticoagulants such as warfarin and heparin are widely used to treat venous thromboembolism, and do not require frequent monitoring to ensure correct plasma levels.
02	Prothrombin time is not a good candidate for a method to measure the plasma concentration of rivaroxaban.
03	Rivaroxaban is a widely used direct inhibitor of activated factor X (Xa).
04	The study cohort comprised 337 healthy individuals (157 males, 180 females).
05	Rivaroxaban (50 mg) was dissolved in 20 mL dimethylsulphoxide (DMSO) to produce a stock solution diluted in phosphate-buffered saline without Ca^{2+} or Mg^{2+} at a final rivaroxaban concentration of 500 mg/mL.
06	A total of 60 rivaroxaban-spiked plasma samples were analysed.
07	To evaluate sensitivity variations among different thromboplastins, plots were drawn for the spiked concentration of rivaroxaban and PT of each sample.
08	Three chromogenic anti-factor Xa assay reagents were used in this study.
09	Specific rivaroxaban anti-factor Xa activity was measured using two different instruments.
10	All three thromboplastins tested showed the same sensitivity to rivaroxaban.
11	The mean (SD) for warfarin-adjusted INR using Neoplastin CI-plus was 1.80 (0.97).
12	Rivaroxaban-adjusted SI values were different from the current warfarin-adjusted ISI in all tested thromboplastins.
13	Rivaroxaban-specific NR does not reduce the differences between the PT results from different thromboplastins and coagulometers.
14	HemoSIL Recombiplastin 2G originates from a human source, so this thromboplastin represents the WHO calibration method.
15	Studies have shown a poor correlation between the anti-factor Xa assay and mass spectrometric measurement of rivaroxaban in normal plasma samples spiked with known amounts of rivaroxaban.
16	The authors found that use of a rivaroxaban-adjusted NR did not minimise inter-thromboplastin variability.
17	Traditional coagulation tests are speedy, widely available and inexpensive, and are suitable for determining plasma DOAC levels.
18	Spiked samples reflect the potential variations of sensitivity between thromboplastins and between *in vivo* samples with similar levels of rivaroxaban.
19	Mass spectrometry, the current validated standard, was not used to measure plasma rivaroxaban concentration.
20	Anti-Xa assay versus NR-rivaroxaban correlation coefficients were 0.97–0.99.

Genetic polymorphisms in DNA repair genes and their association with cervical cancer

Abbas M, Srivastava K, Imran M, Banerjee M. *Br J Biomed Sci* 2019; **76** (3): 117–21.
Assessment No: BJBS1019B

01	Carcinoma of cervix is the third most common cancer among women worldwide, with approximately 530,000 new cases and 275,000 deaths each year.
02	Epidemiologic studies have shown that most cases of cervical cancer are caused by the human papillomavirus (HPV), mainly HPV-16 and HPV-18.
03	Among various DNA repair pathways, base excision repair (BER) restores DNA double-strand breaks.
04	Genetic polymorphisms in DNA repair genes may be associated with repair efficiency of damaged DNA and influence cancer risk.
05	The Arg188His polymorphism of *XRCC1* plays an important role in pancreatic and colorectal carcinogenesis.
06	Cervical cancer patients (*n*=230) and healthy age-matched controls (*n*=270) aged between 30 and 70 years were recruited for the study.
07	Frozen EDTA blood samples were thawed at room temperature and high molecular weight DNA was extracted using a slightly modified salting out method.
08	The sample size for each SNP was calculated by QUANTO software using major allele frequency and prevalence.
09	Of the cervical cancer cases, 93.5% were in stages II/III with 6.5% in stages I/IV.
10	Compared to the GG genotype, adjusted frequencies of GA, AA and GA+AA genotypes were lower in cases compared to controls.
11	Digested products were visualised on 2% polyacrylamide gel after staining with ethidium bromide.
12	Cervical cancer is a complex disease where environmental and genetic factors play important roles in pathogenesis.
13	Women with GA and AA genotypes of *XRCC1*+399A/G showed 2.8–3.4-fold higher risk of cervical cancer.
14	The raw carriage rates of G (+), G (–) and A (+), A (–) showed significant association with cervical cancer when compared to controls.
15	Amplification was followed by initial denaturation at 95°C, followed by 35 cycles at 95°C, annealing at 56°C, extension at 72°C, and final extension at 72°C.
16	The *XRCC3*+18067C/T genetic variant is associated with cervical cancer.
17	The important molecules of the BER pathway are RAD51, XRCC2 and XRCC3.
18	In the study population, the frequency of GA and AA genotypes, and the A allele of *XRCC1*+399A/G are significantly lower in cases compared to controls.
19	Genotypes were determined by polymerase chain reaction-restriction fragment length polymorphism.
20	The major allele frequency was calculated after genotyping 100 normal individuals for each SNP.

REFLECTIVE LEARNING

01	In certain circumstances, monitoring of plasma rivaroxaban concentration might be needed. Discuss.	01	Molecular genetics is set to play an increasing and important role in cytopathology. Discuss.
02	Explain in detail why this paper by Kim *et al.* represents an advance in biomedical science.	02	Explain in detail why this paper by Abbas *et al.* represents an advance in biomedical science.

IBMS Institute of Biomedical Science
Continuing Professional Development

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.

EVENTS AND TRAINING COURSES

DATE	TITLE	VENUE CONTACT
September		
30 Sep-25 Oct	**Introductory Course in Gynaecological Cytology**	Harrow I LNWH-tr.lrctcbooking@nhs.net
October		
7 Oct	**Blood Sciences Workshops and Templates of Haematology**	Birmingham I info@bloodsciencesworkshops.co.uk
7-8 Oct	**Introduction to Practical HPLC Course**	Rochester I stuart@laserchrom.com
8 Oct	**UK NEQAS Clinical Chemistry Roadshow Manchester**	Manchester I birminghamquality@uhb.nhs.uk
9 Oct	**Intermediate Immunohistochemistry**	Sheffield I I.baxter@sheffield.ac.uk
9-10 Oct	**Intermediate Practical HPLC Course**	Rochester I stuart@laserchrom.com
11 Oct-10 Dec	**Regional Educational Workshops 2019: The partnership of AMS & IPC "Stewarding new antimicrobials & IPC practices"**	Various (UK) I ecarruthers@bsac.org.uk
14-16 Oct	**Practical HPLC Method Development Course**	Rochester I stuart@laserchrom.com
14-15 Oct	**Introduction to NGS: DNA**	Cambridge I SREGO1@ILLUMINA.COM
15 Oct	**UK NEQAS Cellular Pathology Technique Mohs workshop**	Gateshead I chantell.hodgson@nhs.net
16 Oct	**UK NEQAS Cellular Pathology Technique BMT workshop**	Gateshead I chantell.hodgson@nhs.net
17 Oct	**UK NEQAS Cellular Pathology Technique renal workshop**	Gateshead I chantell.hodgson@nhs.net
17-18 Oct	**Practical HPLC Troubleshooting Course**	Rochester I stuart@laserchrom.com
19 Oct	**Biomed Online Learning courses 2019**	Online I c.e.ronan@gre.ac.uk
21 Oct	**Quality, Audit and Improvement Workshop**	Croydon I sue.alexander@rmh.nhs.uk
November		
4-8 Nov	**Advanced Practical HPLC Course**	Rochester I stuart@laserchrom.com
6 Nov	**UK NEQAS Clinical Chemistry Roadshow Belfast 2019**	Belfast I birminghamquality@uhb.nhs.uk
11-12 Nov	**UK NEQAS CPT Annual Participants Meeting**	Dublin I chantell.hodgson@nhs.net
11-14 Nov	**FIS 2019: Federation of Infection Societies Conference**	Edinburgh I k.mistry@microbiologysociety.com
12 Nov	**Fine Needle Aspiration Cytology for Technical Staff**	Bristol I SWRCTC@nbt.nhs.uk
13 Nov	**UK NEQAS Cellular Pathology Technique non-gynae cytology beginners/refresher workshop**	Gateshead I chantell.hodgson@nhs.net
13-14 Nov	**Advanced Immunohistochemistry**	Sheffield I I.baxter@sheffield.ac.uk
14 Nov	**UK NEQAS Cellular Pathology Technique non-gynae cytology intermediate workshop**	Gateshead I chantell.hodgson@nhs.net
19 Nov	**Into Clinical Practice: Meeting the Challenges of Gram-negative Infection Management**	London I ecarruthers@bsac.org.uk
26-28 Nov	**BMS/Cytoscreener Update Course in Gynaecological Cytology**	Harrow I LNWH-tr.lrctcbooking@nhs.net
27 Nov	**UK NEQAS Cellular Pathology Technique TEM workshop two**	Leicester I chantell.hodgson@nhs.net
27 Nov	**Update in Cervical Cytology for pathologists, consultant BMS and holders of the Advanced Specialist Diploma in Cytology**	Bristol I SWRCTC@nbt.nhs.uk
28-29 Nov	**Antibiotic Resistance and Mechanisms Workshop for Researchers**	Birmingham I ecarruthers@bsac.org.uk
December		
2-3 Dec	**Agilent HPLC Equipment Servicing Course**	Rochester I stuart@laserchrom.com

DATE	TITLE	VENUE CONTACT
2-5 Dec	**British Society for Immunology Congress**	Liverpool I j.sessenwein@immunology.org
3 Dec	**One-Day Update in Cervical Cytology – HPV cancer audit day**	Bristol I SWRCTC@nbt.nhs.uk
4 Dec	**Medical Laboratory Assistant – Introductory Course**	Harrow I LNWH-tr.lrctcbooking@nhs.net
11th December 2019	**BSAC OPAT Conference 2019 – A Global overview of Drug development and effective use through diagnostics, stewardship and shared learning**	London I ecarruthers@bsac.org.uk
16-17 Dec	**Advanced Agilent HPLC Servicing Course**	Rochester I stuart@laserchrom.com
2020		
March		
2-3 Ma	**Introduction to Practical HPLC Course**	Rochester I stuart@laserchrom.com
4-5 Mar	**Intermediate Practical HPLC Course**	Rochester I stuart@laserchrom.com
9-11 Mar	**Practical HPLC Method Development Course**	Rochester I stuart@laserchrom.com
12-13 Mar	**Practical HPLC Troubleshooting Course**	Rochester I stuart@laserchrom.com
15-16 Mar	**Practical HPLC Troubleshooting Course**	Rochester I stuart@laserchrom.com
September		
7-25 Sep	**HPLC Masterclass Course**	Rochester I stuart@laserchrom.com
17 Sep	**EntericBio Molecular GI Conference**	Limerick, Ireland I sflanagan@serosep.com

HERE TO HELP

HIGHER SPECIALIST DIPLOMAS

The first of two articles in which **Chris Ward**, the IBMS' Head of Examinations, outlines the latest developments around Higher Specialist Diplomas.

The Higher Specialist Diploma (HSD) replaced the Fellowship exam in 2004. Since that time, around 250 candidates, across nine disciplines, have achieved the HSD with the numbers undertaking it growing in the last few years. Many successful individuals have, as a result, obtained job roles at a higher grade and some have become intrinsically involved in the work of the Institute by joining one of the scientific advisory panels.

As part of ensuring that the qualifications that the IBMS offers are fit for purpose and meet the needs of both its members and the wider profession, the Institute's Education and Professional Standards Committee (E&PSC) commissioned an external examiner to review the HSD and to make recommendations on how it could be improved. This report, along with feedback from each of the scientific advisory panels, formed the basis of a full review of the HSD as part of the Institute's 2020 Strategy.

The importance of this project to the Institute is shown by the fact that the work of HSD Review Group was led by the IBMS Deputy Chief Executive.

The group also included the IBMS Executive Head of Education, the IBMS Head of Examinations, representatives from each of the HSD disciplines and a representative of the E&PSC. The recommendations of the review have been accepted by the Institute's E&PSC and changes to the HSD will be introduced over the next 12 to 18 months.

This article and the one that will follow next month describe who the HSD is aimed at, its learning outcomes, what is covered by the HSD and how it is examined and marked.

Aims and Learning Outcomes

The HSD is a Master's level professional qualification that enables biomedical and clinical scientists to demonstrate depth of knowledge of a chosen specialism within the wider professional context, which is required for senior roles. It will be available in the following disciplines:

- Cellular Pathology
- Clinical Chemistry
- Cytopathology
- Haematology
- Immunology
- Leadership and Management
- Medical Microbiology
- Transfusion Science
- Virology.

The award of the HSD shows that the candidate has demonstrated the following learning outcomes:

- A comprehensive understanding of a specific field of biomedical science
- The ability to analyse and interpret information critically in order to address practice-based situations
- Skills in leadership and communication within the healthcare environment
- Critical reflection of personal professional practice
- Knowledge and understanding of current issues and developments within healthcare and how they impact on professional practice.

Eligibility Criteria

In relation to the criteria for those wanting to undertake the HSD, the group decided to remove the recommendation that candidates have a minimum of five years of post-registration experience before they commence the HSD as it was recognised that experience did not guarantee success in the qualification. The more important factor is the ability of the individual to demonstrate that they are operating at an appropriate level and through the completion of the portfolio and passing the exams that they have the knowledge and competence to proceed to more senior roles.

In future, to undertake the HSD, applicants must simply be HCPC registered and have paid membership at Member (MIBMS) or Fellow (FIBMS) grade which must be maintained for the duration of this qualification.

Portfolio Requirements

There are two stages to the award of the HSD. Candidates firstly submit a portfolio that must satisfy the examiners within their chosen discipline that they have met the standard required. The HSD group reviewed the current portfolio requirements and based on their experience of marking portfolios

IMAGES: ISTOCK

"The HSD helps candidates demonstrate discipline specific knowledge in a wider professional context required for senior roles"

agreed to some changes in relation to what should be included in it. From May 2021 the submitted portfolio must contain:

- A 500 words (±10%) personal professional profile that describes the professional experience, current job role and responsibilities of the candidate
- Two cases; one on a clinical issue and one a managerial issue. Each must be 1,500 words (±10%). It must be clear the level of personal involvement that the candidate has had and whether a clinical case or a managerial report they must demonstrate a systematic approach, show insight and wider understanding of the condition or issue, current knowledge and relevance to their scope of practice
- Two essays each of 3000 words (±10%) based on titles on the IBMS website
- Evidence of an oral presentation – with feedback from appropriate colleagues
- One reflective statement of 2000 words (±10%) that articulates how the candidate identified gaps in their knowledge, the actions they took to address these and the rationale behind their choice of action(s). It should also show how their preparation for the HSD has contributed to their professional practice.

Next month, I will explain the HSD exam structure, how it is marked and how unsuccessful candidates will be able to 'bank' their results in certain papers ahead of any re-sit attempt.

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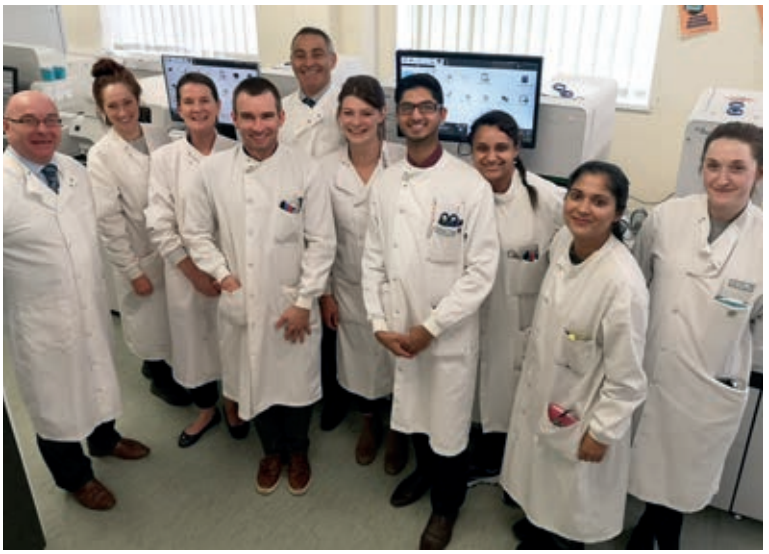
MY LAB

MAJOR TRAUMA CENTRE

Rizwan Shakir gives a guided tour of his laboratory at the Royal Preston Hospital.



Lancashire Teaching Hospitals NHS Trust is the regional specialist centre for major trauma, cancer, disability services, renal, vascular, neurosurgery and neurology.

The trust consists of Royal Preston Hospital and Chorley and South Ribble Hospital. We serve a population of 1.5 million.

In haematology alone, we process approximately 12,000 FBCs per month, 6,000 coagulation samples per month and 5,000 to 6,000 haemoglobinopathy samples per year.

We have a specialist anticoagulation service run by anticoagulant nurses who work alongside the biomedical scientists. Royal Preston Hospital offers specialist coagulation tests, which are batched and processed once a month, unless urgent, as well as specialist testing requested by haematology consultants.

In blood transfusion we process over 40,000 group and screen samples per year and are transfusing approximately 1,000 blood units a month. We also process our own antibody panels, provide factor products and provide Kleihauer tests.

As a major trauma centre, we have to ensure we have enough blood to supply the hospital during a trauma or multiple traumas. We have two satellite fridges to stock these units.

We provide a range of analytical and advisory services for the trust, both inpatients and outpatients, and GPs along with diagnostic services to a range of other health care providers.

To ensure the highest standard of work, we are an ISO: 15189 UKAS accredited laboratory. We ensure that our staff are trained to a high level and pride ourselves in the training and knowledge given to all staff that work with us.

We have excellent CPD schemes, morphology meetings and training courses to ensure that the staff are kept up to date with the world of science.

We have assisted in developments in point-of-care analysis by taking pathology to the patients. For example, full blood count with differential count for early neutropenic sepsis screening and anticoagulant therapy at point-of-care clinics.

We are continually making patient blood management developments to make pathology better, such as introducing digital pathology (DI60) .This project is well underway and once up and running will see further benefits to patients. The laboratory is looking to add a track system for coagulation analysers streamlining the work even more. This has been made possible by our senior management – Steve Hambridge, Alan Noyon, Nicola Peacock and Derek Wallbank, who are very passionate about the project and the laboratory.

The staff who work here are very friendly and we took part in Biomedical Science Day 2019 and won "Best individual workplace photo 2019".

We are an excellent team who pride ourselves in the work we provide for our patients and service users. We are a training laboratory which has supported STPs, PTPs and placement students through their portfolios and provided them with the knowledge and skills necessary for their future careers. We welcome staff from all disciplines to have a look around the lab to see what we do and show how important biomedical scientists are. BMS

Rizwan Shakir is a biomedical scientist working in haematology and transfusion at Royal Preston Hospital.

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