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INSIDE

Assuring the safety of vaccines

The plastisphere

Mandatory childhood vaccination

Latin anyone?

@Nicky_lab_brat

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Copy dates

Vol. 22 No. 2 June 2021
Wednesday 14 April

Vol. 22 No. 3 September 2021
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You don't have my attention

A 'you don't have my attention' glare is a look I have seen in many a Zoom-face over the last 12 months. The pandemic forced many organisations like the Society for Applied Microbiology to adopt virtual formats for their conferences and meetings, and with free registration – participation rocketed. But many of these virtual conferences are not serving the needs of this much more diverse and international scientific community.

It is not enough these days to simply translate a traditional in-person event to an online format. It can be difficult to hold a virtual audience's attention at the best of times, but with many of us socialising, working and learning in this environment, sitting through numerous hour-long slide-based presentations is the last thing we want to do. When this is optional, many of us will opt out.

The committees and staff responsible for the SfAM online events featured in this issue of *Microbiologist* relentlessly focus on a quality audience experience. There are shorter, punchier, interactive speaker sessions with the ability to watch offline and submit questions beyond the event. Subtitles (when possible) to enable silent viewing, and the more personal networking, workshop and community sessions are designed to leave the delegate feeling motivated, productive and less isolated.

Having information provided to us in a digital format is by no means a new phenomenon, but as organisations streamline their events to keep people's attention, we are being offered top-class keynote speakers that we actually want to hear from!

But scientific meetings and conferences are more than just speakers; many new collaborations and partnerships are formed at these events. Traditional poster sessions, for example, are still an extremely important method of communication for early career researchers who need to increase their visibility and gain exposure. However, many of these young people have been networking online since they received their first smartphone. This group of individuals have led the way in determining what they need from a virtual event and have organised two of SfAM's biggest collaborative conferences – the ECS Symposium (page 12) and the International Microbiology Conference (page 50). These events do not simply replace aspects of in-person conferences but offer innovative approaches that allow dynamic virtual interactions that take inspiration from television, social media and online gaming.

We will always crave face-to-face interactions, but for those organisations that have embraced the digital move, designing any future programme of events has just got a lot more challenging.

…and talking of events, I suggest you turn to page 21 first, as you now only have three days to register for the Vaccine Hesitancy event.

Paul Sainsbury
Editor

> My daughters and I are privileged to have a good education and many opportunities, but this is not the norm throughout most of Africa. Evidence shows that African women and girls bear the brunt of poverty and elimination of this bias must start with their education.
>
> **Dr Yemesi Jeff-Agboola**
> Page 09

News

Features

Must-read Articles

People & Places

Education & Public Outreach

Policy & Public Affairs

Industry

Unparalleled achievements

On 8 December last year, a 91-year-old grandmother, Margaret Keenan, became the first person in the UK to be administered the first of two doses of the Pfizer/BioNTech COVID vaccine. Regulatory approval for the Oxford-AstraZeneca vaccine and the Moderna vaccine followed swiftly on 30 December 2020 and 8 January 2021, respectively. At the time of writing, over 18 million people in the UK have had at least one dose of a COVID vaccine, and with current rollout rates 16 million people will have received their first dose of the vaccine by the middle of February.

It's well worth reflecting on; three vaccines developed, trialled and approved and several more in late-stage development, to combat a new coronavirus pandemic, all within a year of the first reported cases of SARS-CoV-2. By any measure, it is a remarkable feat of human endeavour and an achievement unparalleled in the history of medicine. Of course, some challenges remain, with new variants of the virus now becoming widespread in a number of countries, with information on the likely efficacy of these vaccines now emerging. Despite this, the speed at which new vaccines have been developed, the diversity of approaches to vaccine design and the speed at which production, validation and regulatory approval have taken place is nothing short of incredible. If politics is the art of the possible then science is surely the art of making the impossible possible.

These successes, after a year of tribulations, personal sacrifice and tragic loss, bring hope for a return to aspects of normal life. They also point towards the unfathomable value of the science base, not only here in the UK but across the world, and the importance of continuing to support and invest in both private and public sector scientific research and development. It's always hard to predict when and from where scientific discoveries will arise, so investing in and maintaining a diverse science base is an essential part of any future pandemic preparedness, and also our ability as a society to respond to emerging global challenges including antimicrobial resistance, food safety and security, climate change, the health of our oceans and addressing health inequalities around the globe. A flexible and diverse science base is the foundation of a healthy economy and a healthy society. At SfAM we support scientists working in all areas of applied microbiology, across a wide range of disciplines, from science outreach activities in the classroom, right through to undergraduates, PhD candidates and scientists at all career stages in the public and private sectors.

Brendan Gilmore
Queen's University Belfast

Late last year it was my pleasure to inform our 2020 recipient of the WH Pierce Prize, Dr Joan Geoghegan from the Institute of Microbiology and Infection, University of Birmingham, that she had been awarded the Society for Applied Microbiology's most prestigious award in recognition of her outstanding contribution to the understanding of the molecular basis of *Staphylococcus aureus* colonisation, biofilm formation and infection. The WH Pierce Prize is awarded annually to an early career microbiologist who has made a substantial contribution to the science of applied microbiology. Nomination (by members of the Society only) for the 2021 prize is now open, so please consider putting forward a nomination. You can read more about Dr Joan Geoghegan and her world-leading research later in this issue.

In February, SfAM joined forces with the National Biofilm Innovation Centre (NBIC) for a one-day virtual meeting 'Microbes and Biofilms in the Food Industry', with nine excellent speakers from the UK, Ireland and the USA and over 300 delegates, discussing the challenges of controlling microbial contamination, new technologies, biocides and regulatory control of contamination control measures in the food industry. Our varied and exciting programme of events for the remainder of the year is available on our website. In particular, I am looking forward to the Early Career Scientist (ECS) Research Symposium 2021, this year celebrating its 10th birthday and running from 22 to 26 March. The week-long event highlights and celebrates the very best of our early career scientists from industry and academia. Providing opportunities to present, listen, network and participate, this is a symposium not to be missed. I encourage you to support our early career scientists, the lifeblood of our Society and the future of our discipline, by joining us in March. I wish all of our ECS Committee and contributors a successful meeting and fruitful networking! I thank them for their dedication and hard work in organising this superb programme of talks and events, and for the valuable contribution they make to our Society. As we move from winter to spring, I look forward to continue working with and hearing from our members, and to seeing you (hopefully in person) at a future meeting.

These successes, after a year of tribulations, personal sacrifice and tragic loss, bring hope for a return to aspects of normal life

Bringing gender into focus

As well as bringing into focus the scientific process in a very public way, the global pandemic has shone a light on many societal inequalities, including gender discrimination. One example of this has been academic journal submissions: despite an overall increase in submissions to life science journals during 2020, the number from female first authors began to decline in March and continued to fall in April and May.[1]

I'm putting this article together a few days before International Day of Women and Girls in Science 2021. The UN's description of this day states:

'Over the past 15 years, the global community has made a lot of effort in inspiring and engaging women and girls in science. Yet women and girls continue to be excluded from participating fully in science.

'At present, less than 30% of researchers worldwide are women. According to UNESCO data (2014 – 2016), only around 30% of all female students select STEM-related fields in higher education. Globally, female students' enrolment is particularly low in ICT (3%), natural science, mathematics and statistics (5%) and in engineering, manufacturing and construction (8%).

'Long-standing biases and gender stereotypes are steering girls and women away from science-related fields. As in the real world, the world on screen reflects similar biases—the 2015 Gender Bias Without Borders study by the Geena Davis Institute showed that of the onscreen characters with an identifiable STEM job, only 12% were women'.

The role of representation is important in breaking down barriers and here at the Society we hold Equality, Diversity and Inclusion at the **heart of what we do**. https://sfam.org.uk/knowledge/policy/equality-diversity-and-inclusion-ed-i.html.

Of the members who responded to our end-of-year survey in December 2020, the gender split was 53%:47% male: female. This, and the current gender balance of the SfAM Executive Committee (EC) (50%:50% male:female), are both an improvement on the gender balance of the EC announced in early 2019 (62%:38% male:female). This reflects, in part, the impact of the positive steps we've taken to place Equality, Diversity and Inclusion at the Society's core.

Scientific progress, such as the development of vaccines, needs great minds and the gender identity, race, sexuality or ability of the body that supports that mind must not matter. There is still work to do and we will continue to learn and develop our Equality, Diversion and Inclusion work, but for now I'm proud of the work the Society is doing to welcome all applied microbiologists into the SfAMily.

Lucy Harper
Chief Executive of the Society for Applied Microbiology

[1] https://www.timeshighereducation.com/news/pandemic-lockdown-holding-back-female-academics-data-show?utm_source=hootsuite&utm_medium=linkedin&utm_campaign=general&utm_term=digital%20science

International Day of Women and Girls in Science
11 FEBRUARY 2021

International Women's Day #choosetochallenge
8 MARCH 2021

Dr Elaine Cloutman-Green BEM LEAD HEALTHCARE SCIENTIST / CLINICAL LECTURER

'As part of a course, I did a project on surface modification to prevent infection in catheterised spinal injury patients. For the first time I saw how science could make a difference, not in 10 years but quickly and for patients. I knew this was the kind of science I wanted to do'.

Dr Yemesi Jeff-Agboola SfAM INTERNATIONAL MICROBIOLOGY CONFERENCE COMMITTEE CHAIR

'Women still face major challenges and obstacles in Africa, with their contributions to the economy not properly recorded or recognised. The most inhibiting factor is they continue to be denied an education and we know that poverty decreases when more women and girls are educated. Women and girls need to see more action being taken to achieve gender parity and not just a list of wishful goals and aspirations. We are not the faces of poverty, but the keys to overcoming it'.

Dr Joan Geoghegan WH PIERCE PRIZE WINNER 2020

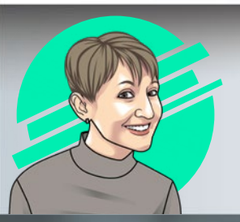
'Establishing my own research group and contributing to the mentoring of the next generation of microbiologists will never stop feeling like a great achievement and one of which I am incredibly proud'.

Hannah Brace-Thompson SEROLOGY LAB TECHNICIAN

'While studying full-time, I carried and gave birth to my son, was diagnosed with general anxiety disorder, and had to cut my honours project short and finish my thesis during the initial COVID-19 lockdown. But, despite all the bumps –pun intended– I have finally achieved my lifelong dream of doing scientific work in a laboratory'.

Professor Dame Sally Davies UK SPECIAL ENVOY ON ANTIMICROBIAL RESISTANCE AND FORMER UK CHIEF MEDICAL OFFICER

'The reason I put Athena Swan into National Institute for Health Research (NIHR) as a condition for getting grants was because women make up 51% of our population and you can't afford to throw away half of our best brains – let alone the fact that it's not fair. You have to speak up and tell people 'this is not right', because most people know it's not right by now. Change is challenging but worth it, so my advice to young women and girls in science is simply… GO FOR IT!'



Dr Lucy Harper SfAM CHIEF EXECUTIVE

'In the beginning I lacked confidence in my ability. Some of that was down to not being able to identify with my mentors or tutors – all of whom were men. So now, when I can, I talk to women and girls about science and scientists'.

Things can only get better

2020 was a year of constantly shifting aspirations, which played a huge part in what made it so tough – what we thought we knew for sure kept changing. This was especially true for our ECS members who have faced continuous uncertainty and upheaval throughout the year.

At the start of 2020 I figured that if I managed to do all the work that I had planned and attend all the conferences I'd booked on to then I could travel around, show off my research and maybe even come away with a paper to show for all my hard work. Last January I got on to it – ordering consumables, training on new equipment, learning to code, applying for travel grants, and I even made the poster I would present at the ECS Symposium! By the end of February, I was all set and ready to start putting all that groundwork into action. Less than a month later all the conferences were cancelled, the lab was closed, and I was stuck at home.

I told myself this would last for a month or two and then we would have got the situation under control to be able to return to work. The news definitely made it seem like lockdown would only be a few weeks, so I focused on cancelling the train tickets I had booked to get to conferences and set about promising myself I would get through the backlog of unread papers I had been accumulating since the start of my PhD.

Caleb Marsh
ECS Committee Lead Communications Officer

It was around this point that supermarkets started to have empty shelves. I will admit I laughed a little at the prospect of a toilet paper shortage, and a little less when we started running out of the flour that fuels my baking hobby, but when we were facing shortages of critically important PPE and testing reagents there was a distinct lack of a funny side. The lockdown continued and a family holiday in Greece was replaced with binge-watching *The Office* in the same room that I had been working from home in the day before.

I was fortunate enough to return to the lab by mid-July. I tried to get back firing on all cylinders but was quickly reminded that lab skills are just like a muscle – if you don't use them, they weaken. Everything took me twice as long to do and I would make mistakes twice as often. Strict time limits on when we were allowed in the lab meant that staying an extra hour to finish a protocol was not an option, making every mistake devastating. Being forced to sit outside for lunch was probably a good thing though as I may not have left the lab all day otherwise.

Like many of us, I felt a huge pressure on myself to 'catch up' to the targets I had set myself in January, which meant I quickly started to burn out. I got a little wind in my sails when I started to tick off some milestones, but that wind changed when UK Research and Innovation (UKRI) announced they would not be extending PhD funding and that students should 'mitigate their research'. This cycle defined 2020 for me: things seem like they are set to get better and then they don't.

When the pandemic first arrived in the UK, everyone was saying this was the start of us developing into a more caring society (we were outside clapping our hands and bashing pots and pans to show support for our carers). I didn't really believe it at the time, but after trying to comfort a close friend in my lab from two metres away who was crying behind their facemask, I realised how important it was that we work together to support our community – because it's rough out there.

The ECS Committee has been working hard to create a supportive environment and being on the committee has been a great source of sanity for me personally in the past 12 months. This year's ECS Research Symposium is kicking off with a series of community corners that provide a safe environment to talk about the issues that we face as scientists – including a session for COVID's impact on STEM. SfAM has also been working hard on launching the Quorum Forum, another place where members can talk about the issues they are having or even just to have a good vent – a bit like I have done in this column!

***Join us for the ECS Research Symposium 22–26 March, book now at* www.sfam.org.uk**

What gets us into trouble is not what we don't know; it's what we know for sure that just ain't so

Mark Twain

22–26 MARCH 2021

10TH ECS RESEARCH SYMPOSIUM

This online event features keynotes from diverse fields, a variety of interactive workshops, networking sessions and the beloved SfAM quiz! We can't wait to see you there!

All times GMT

WELFARE COMMUNITY CORNER SESSIONS

Monday 22 / 15:00 – 16:00

NETWORKING SESSION

Thursday 25 / 15:00 – 16:00

WORKSHOPS

POLICY

Tuesday 23 / 15:00 – 16:00

UNDERGRADUATE

Wednesday 24 / 15:00 – 16:00

INDUSTRY

Thursday 25 / 12:00 – 13:30

CAREERS

Friday 26 / 15:00 – 16:00

Register at

www.sfam.org.uk

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KEYNOTES

Professor Duncan Cameron
University of Sheffield

AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY

Monday 22
12:00 – 13:00

Professor Tania Dottorini
University of Nottingham

BIOINFORMATICS AND MACHINE LEARNING IN MEDICINE

Monday 24
12:00 – 13:00

Professor Julian Marchesi
Cardiff University

DENVER RUSSEL MEMORIAL LECTURE: MICROBIOME IN HUMAN HEALTH

Monday 26 / 12:00 – 13:00

SFAM QUIZ

Thursday 25
19:00 – 20:00

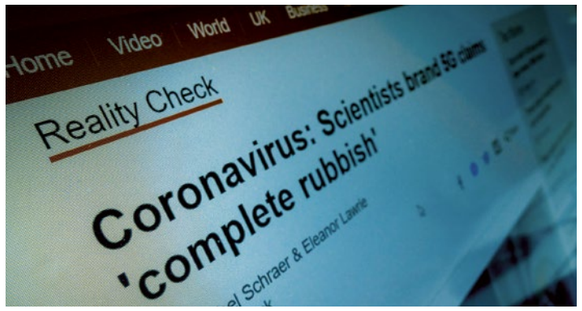
sfam ECS EarlyCareerScientists

A psychological 'vaccine' against fake news

Rakoen Maertens and **Sander van der Linden**
University of Cambridge, UK

As governments across the world are rolling out COVID-19 vaccination policies, they are not only facing challenges around vaccine logistics but are also fighting an uphill battle against the onslaught of 'fake news'. In fact, commentators have argued that misinformation might be the most contagious thing about the virus. The consequences of belief in fake news can be dangerous, whether it concerns fake cures that lead people to ingest harmful substances or vandalisation of the 5G network infrastructure because of false assertions that there is a link between radiation and COVID-19. In our recent research, we found clear evidence that belief in common misinformation about the virus is strongly associated with reduced intentions to get vaccinated and a lower likelihood to recommend the vaccine to others. We therefore need an effective way to counteract and tackle the spread of misinformation in society.

Despite years of research in cognitive and behavioural science on how to curb the impact of misinformation, a magic bullet solution for the problem has not been found. The classical method is known as *debunking* and entails issuing a correction after people have already been exposed to a falsehood. This method leaves much to be desired because it often requires repeating the myth in an effort to debunk it. We know that the more someone is exposed to a myth, the more familiar the myth feels, and the more weight the brain will give the claim in memory retrieval: an effect known as the *illusory truth effect*. In other words, when fact-checking misinformation, there is always a risk that the myth becomes more readily available in one's memory, potentially leading to a negative effect that reinforces the myth while people easily forget about the correction. Sometimes the benefits of debunking outweigh the adverse effects of potentially increasing familiarity through repetition but even when debunking is effective, it does not solve the problem: the spread of



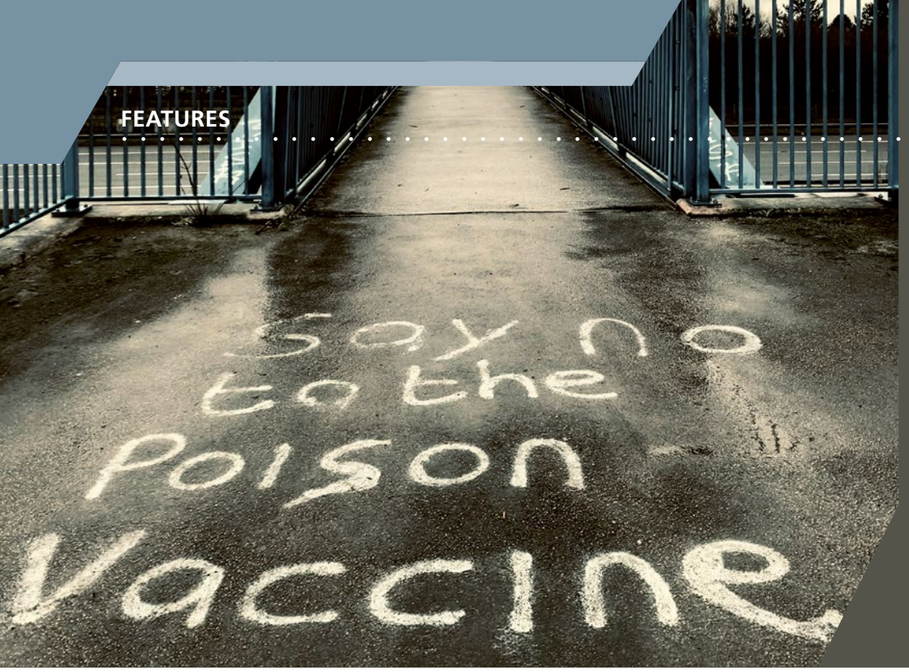
misinformation—especially on social media—outpaces the rate at which we can fact-check and so people are repeatedly fooled by manipulative information. In other words, debunking is never agile enough: even if it works, the damage is often already done, and the myth continues to spread.

This leads to the natural question of whether we can prevent misinformation from taking root in the first place? In the 1960s, American psychologist William McGuire developed a framework known as *inoculation theory,* which closely follows the biomedical analogy. In brief, McGuire posited that—similar to a biomedical vaccine—the 'cognitive immune system' needs to become familiar with a weakened version of the 'virus' (the manipulation attempt) in order for it to develop 'mental antibodies'. At the time, McGuire was thinking about people's susceptibility to propaganda during the Cold War and whether it was possible to produce a 'vaccine against brainwash'. Although he had some initial success with his experiments, showing that people can become more immune to persuasion when they are forewarned and exposed to a severely weakened version of the 'persuasive attack', he never quite tested his ideas in the context of propaganda, and the theory slowly faded into history.

Sixty years later, at the Cambridge Social Decision-Making Lab, we decided to renew focus on inoculation theory. One insight that McGuire may not have foreseen is that we can

now actually borrow models from epidemiology to study the spread of information pathogens. Misinformation is highly contagious as it can spread from one person to another without the need for physical contact. The vaccine analogy has, therefore, never been more apt.

To develop a scalable vaccine that provides long-term cognitive protection against a wide range of misinformation pathogens, we further developed the prophylactic framework of inoculation theory—otherwise known as '*prebunking*'. To illustrate how this approach works in a controlled laboratory environment, we started by evaluating whether we could distil a sufficiently weakened dose out of a specific myth: misinformation about climate change. In particular, we used a screenshot of a real website that hosts a bogus petition allegedly signed by thousands of scientists claiming that global warming is a hoax. In the experiment, we forewarned people about the petition (without naming it) and provided them with a pre-emptive refutation (a weakened dose that contains the 'prebunk'). For example, the forewarning message contained an explanation of the flaws and fallacies utilised in the misinformation (e.g. the use of fake experts, including false signatories such as



Graffiti on a Manchester motorway bridge about COVID-19 being a hoax

Charles Darwin and members of the Spice Girls). The warning and weakened dose are meant to trigger people's vigilance and attention (to start the production of mental antibodies), and the message offers people concrete ways to resist the misinformation. After people were inoculated, participants were exposed to a full dose of the misinformation. Our findings showed that while those who received a placebo treatment were negatively impacted by the misinformation, inoculated participants were substantially less likely to be fooled by it. This experiment was replicated three times and extended to show that even one week after the intervention, inoculated individuals were still protected against the misinformation attack.

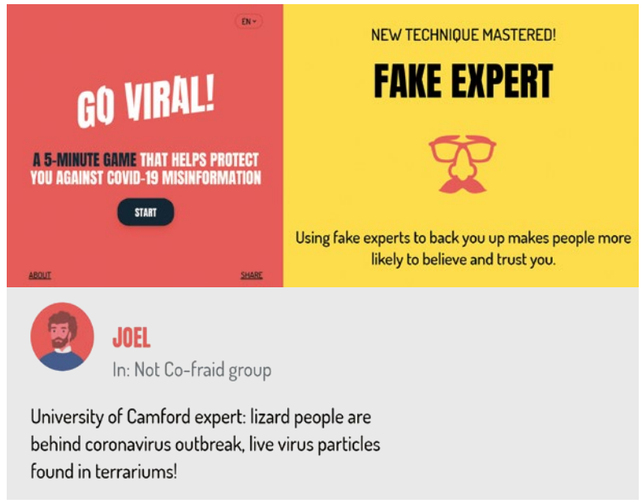
After some initial success with an isolated issue in one context, we successfully developed the first vaccine of the second generation: an intervention to inoculate people against a broad range of misinformation tactics. Rather than trying to pre-empt every single myth, we deemed it more efficient to develop a broader-spectrum vaccination that targets the very building blocks of the misinformation virus itself (its nucleic acid). After a year's worth of investigation, we identified the techniques common to nearly all online misinformation; 'The Six Degrees of Manipulation': discrediting, appealing to emotion, group polarisation, impersonation (e.g. fake experts), conspiracy theories and trolling. An important second theoretical innovation was that we wanted to simulate a social media feed to increase the validity of our testing environment. This also allowed us to examine the notion of 'active inoculation' or the idea that instead of passively providing people with the facts beforehand, you let people generate their own intellectual antibodies in an interactive learning setting.

Accordingly, in collaboration with the Dutch media literacy organisation *DROG*, we designed the inoculation-based game *Bad News* (**getbadnews.com**). In the game, participants take on the role of misinformation producer and aim to gain followers (whilst maintaining their credibility) by creating and sharing manipulative news headlines according to one of the six degrees of manipulation. During gameplay, players are forewarned about the dangers of fake news and are exposed to weakened doses of the six manipulation techniques in a controlled environment, often using humour. Importantly, these doses are strong enough to trigger people's motivation to learn how to protect themselves but not so strong as to actually dupe them (or infect people with the virus). Players typically participate in a quiz beforehand where they are asked to rate how reliable they find a large series of posts that are either credible news items or items that contain one of the key misinformation techniques. Notably, the test items are different from the training items used in the game. Both big data samples (of people who voluntarily play the game) as well as randomised controlled trials on the *Bad News* game have shown that it effectively reduces people's susceptibility to fake news headlines, that the game boosts people's confidence in their own ability to discern manipulative from credible news and reduces self-reported readiness to share fake news.

After these promising findings, we decided to further test and evaluate our intervention with the UK government. The government helped translate the game into 20 languages around the world, which enabled us to do additional large-scale cross-cultural replications with positive results. The game has now been played by over a million people around the world and is implemented in high school and university curricula in several countries.

Following the recent declaration by the World Health Organization (WHO) of a worldwide 'infodemic' and the success of our second-generation vaccine, we set out to develop a similar inoculation game to help protect people against the harmful impact of COVID-19 misinformation specifically. Together with the UK Cabinet Office and with support from the WHO and United Nation's *Verified* campaign, we launched *GoViral! The GoViral*! Game prebunks three common techniques used to spread misinformation about the coronavirus: fearmongering, the use of fake experts and conspiracy theories.

Although these advances are promising, we needed to know more about the long-term efficacy of the cognitive vaccine. Similar to how it is imperative to determine the long-term effectiveness of COVID-19 vaccines, research on inoculation-based interventions will need to investigate how to increase the interventions' long-term success. In general, the literature shows that the benefits of cognitive inoculation remain intact for up to two months, but that its effectiveness starts to dissipate after a few weeks. Importantly, research has found evidence for the potential of 'booster sessions'. Just like for the Pfizer vaccine—where a booster jab is needed three weeks after the initial injection—cognitive immunity can be prolonged with an additional 'booster shot'. In an experiment with *Bad News*, we found evidence for inoculation effect decay after two months when we excluded follow-ups, but full retention of the protective effects for at least three months after three booster sessions.



*Screenshot of GoViral!, a game illustrating the fake expert technique (**www.goviralgame.com**).*

Ultimately, we aim to follow the vaccination analogy to its logical conclusion: herd immunity. Psychological vaccines do not work in exactly the same manner as biological vaccines of course, their efficacy is nowhere near 95% immunity and they wear off over time if not boosted regularly. Having said this, we are currently running computer simulations to try to estimate what percentage of a population needs to be vaccinated at a sufficient rate within a given (online) community to effectively contain the spread of misinformation. To help ensure that misinformation-induced vaccine hesitancy does not spread further, governments, schools, technology companies and civil society can therefore help spread and scale the vaccine. For example, some social media companies, such as Twitter, have already started experimenting with prebunking on their platform. We are currently collaborating with Google, who through their research and innovation hub Jigsaw, is helping us to develop short inoculation videos, which could be embedded as an advertisement on, for example, YouTube (before people are exposed to misinformation). However, at the end of the day, we need a multi-layered defence system. We need to prebunk first where possible, but also continue to rely on real-time fact-checking as well as debunking after the fact if needed. Only if these combined pre- and debunking measures are implemented quickly, widely and in various settings, will we be able to contain the spread of misinformation in society.

At present, we do not yet know at what rate the misinformation virus evolves, but we know it is getting more sophisticated. As with any virus, we have to stay alert and be ready to update our vaccines whenever a new variant of misinformation arises. In the words of the renowned Defence against the Dark Arts Professor, Severus Snape, 'our defences must be as flexible and inventive as the arts we seek to undo'.

FURTHER READING

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Assuring the safety of vaccines

Caroline Vipond
The National Institute for Biological Standards and Control (NIBSC), UK

A vaccine undergoes a comprehensive regime of testing, and its use is subject to continuous vigilance throughout its lifecycle to ensure safety, efficacy and quality. The evaluation begins at the pre-clinical stage of vaccine development and progresses stepwise through to the licensed vaccine.

Clinical trials are the primary process for testing vaccine safety and efficacy in humans. They are run in a stepwise or phased manner, but before any medicine is administered to humans it undergoes rigorous pre-clinical testing. In the case of vaccines, this includes an in-depth toxicological assessment in animals. Typically, animals are administered a dose of vaccine, which at least matches the highest dose proposed for human trials. Animals are observed for any adverse reactions focusing on undesirable inflammatory responses. Subsequently, a full autopsy will be undertaken to examine organs for signs of adverse effects alongside analysis of relevant samples, taken throughout the study, to measure the immune response to the vaccine. On successful completion of the study a vaccine developer applies to a national regulator to run phase I clinical trials.

Phase I, or first-in-human trials, are typically run in a small number of healthy adults and are primarily designed to ensure the vaccine does not cause serious adverse events.

Pre-clinical

- Safety
- *In vivo* toxicology

Phase I

- First in human
- 20–80 healthy adults
- Safety
- Appropriate dosing

Phase II

- Hundreds of participants
- Safety
- Optimal dosing
- Vaccine regime
- Control group
- Double-blind and randomised

Clinical trials are the primary process for testing vaccine safety and efficacy in humans. They are run in a stepwise or phased manner.

Additionally, the studies may be used to identify an appropriate dose of the vaccine that evokes an immune response. Once completed the vaccine progresses to phase II clinical trials. These evaluate the safety of the vaccine in a larger population, usually hundreds of people, as well as providing crucial information on optimal dosing and appropriate vaccination regimes. Critically, these trials include a control group, are randomised with participants arbitrarily assigned to a group and ideally are double-blinded so neither the participant nor the researcher know who has been administered the developmental vaccine or the control. Phase III trials follow and involve thousands to tens of thousands of participants comprising a range of age groups, from infants to elderly, providing a comprehensive safety profile of the vaccine. Importantly, these trials enrol a sufficient number of the target population to be powered to provide statistically significant safety and effectiveness results. In phase III trials, groups may be included to assess concomitant administration with other routine vaccines; for example, to determine whether a candidate paediatric vaccine interferes with other vaccines in an infant immunisation programme.

Phase III

- Thousands to tens of thousands of participants
- Target vaccine group
- Comprehensive safety profile
- Control groups
- Concomitant administration

Approval

Dossier submission to regulatory authority containing in-depth analysis

- Clinical data
- Quality data

Phase IV

Pharmacovigilance

Detection, assessment and prevention of adverse reactions

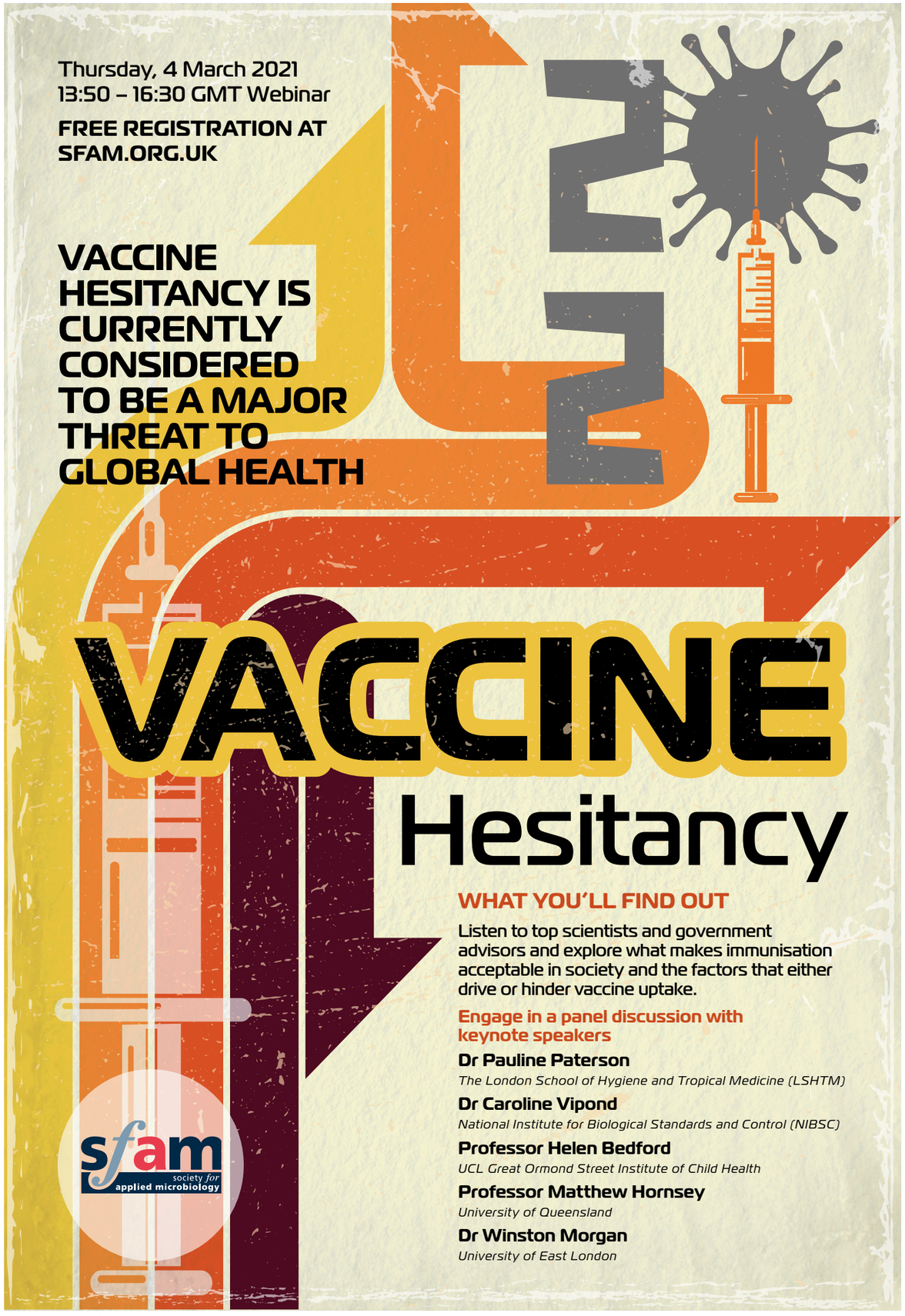
Batch release

Laboratory testing to measure safety, efficacy and quality attributes

Once the candidate vaccine has completed the clinical trials, the manufacturer submits a dossier to the relevant regulatory authority for authorisation to administer the vaccine in the population in its jurisdiction. The dossier is an in-depth report containing analysis of clinical studies, and descriptions of manufacturing and quality processes. The assessors review all data and make a recommendation on whether the vaccine should be used in humans and any limitations that apply.

Upon authorisation, both the vaccine manufacturer and the regulatory authority implement post-licensure surveillance based on a previously agreed risk management plan. Batch release testing of every vaccine lot is also undertaken to ensure the consistency of every batch with those shown to be safe and effective in clinical trials. The manufacturer is required to run an exhaustive panel of quality tests as described in the marketing authorisation (licence). Test results are submitted along with samples of each batch to the national control laboratory, such as the National Institute for Biological Standards and Control (NIBSC) in the UK, who review the manufacturer's data and run independent tests focusing on vaccine safety and potency. On successful completion of all tests the vaccine batch is issued with a certificate permitting it to be marketed in the designated country. Pharmacovigilance (part of phase IV trials) is performed by the manufacturer and the national regulator. Pharmacovigilance is the detection, assessment and prevention of adverse events caused by the vaccine. Whilst thorough, the evidence of safety of a vaccine prior to its authorisation is limited to a relatively small group of people, over a narrow time period with a small number of batches. It is possible that changes occur during product manufacture that are undetected by the QC testing, or administration with another medicine causes an adverse event, or there may be rare underlying conditions in patients, which result in adverse events that were not identified in the trials. Identifying an adverse reaction from a vaccine requires data from multiple sources including physicians, pharmacists and patients. In the UK, members of the public and healthcare professionals can report suspected safety issues or adverse reactions via the **Yellow Card scheme**. Data from all sources are combined by the regulators and manufacturers in real time to identify any potential issues at the earliest possible moment allowing effective intervention.

The first clinical trials occurred centuries ago, building the foundations for the intensive testing regimen applied to vaccines today. As new state-of-the-art methods and technologies are developed with improved sensitivities, efficiencies and capabilities so they are adopted by regulators, control laboratories and manufacturers to ensure ever-improving safety and surveillance mechanisms are in place to continually protect public health.



FEATURES

A psychologist's perspective

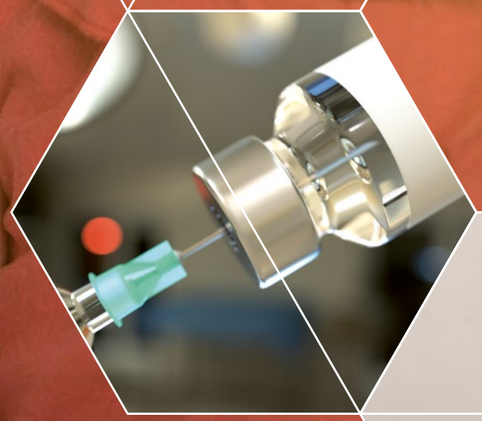
Parental decisions about vaccination: concerns between exploitation & neglect

Kaja Damnjanovi
Department of Psychology, University of Belgrade, Serbia

'What is a vaccine?' is a clean question that yields at least two opposite answers stemming from different reference points depending on the role of decision-makers.

A vaccine is a superbly elegant way of utilising nature's own adaptive mechanism of informing the immune system about the presence of a specific pathogen or disease, which makes us prepared and immune. That information could be coded in a live, attenuated (weakened) or inactivated (killed) microorganism or virus, or proteins or toxins from the organism, e.g. only 10 antigens are enough in a pentavalent vaccine, in comparison to the million antigens a baby is exposed to in the mother's birth canal. Before it was named 'vaccination' (meaning 'from a cow'), then tested and refined, this adaptive mechanism had been observed in farmers immune to smallpox from previous exposure to the less severe cowpox, which rarely kills. This is neither a decision, nor a choice, and any potential debate about the usefulness of this procedure is frowned upon in science. This would be the stance of healthcare professionals, the health system and public servants.

For parents, studies show, vaccines are one of the public health measures, mandatory or at least recommended by the government and the above-mentioned distant scientific elite, which they, the parents, have a duty (via official consent) to carry out. For parents, who are both legally responsible and emotionally attached to their children, this is an exercise of parental responsibility in the realm of the already flourishing public debate about necessity, benefits and possible alternatives to immunisation via vaccination. Out of all the roles in this social process, parents relate to this debate strongly, since they act as proxy decision-makers for their children. It is one of the most involving decisions a parent makes, and this high involvement leads to overemphasising the potential side-effects. Indeed, for parents, the vaccine is conceptually vague and based on a somewhat counterintuitive procedure of injecting, 'the virus itself' (sic) into an already healthy organism – to remain healthy. However, in discussions about vaccinating their children, parents emphasise consideration of the purpose and safety of vaccination rather than on the procedure itself, which is accompanied by limited knowledge. In addition, a specific pattern of trade-off between two fears of the uncertain outcomes was registered over time, historically, and

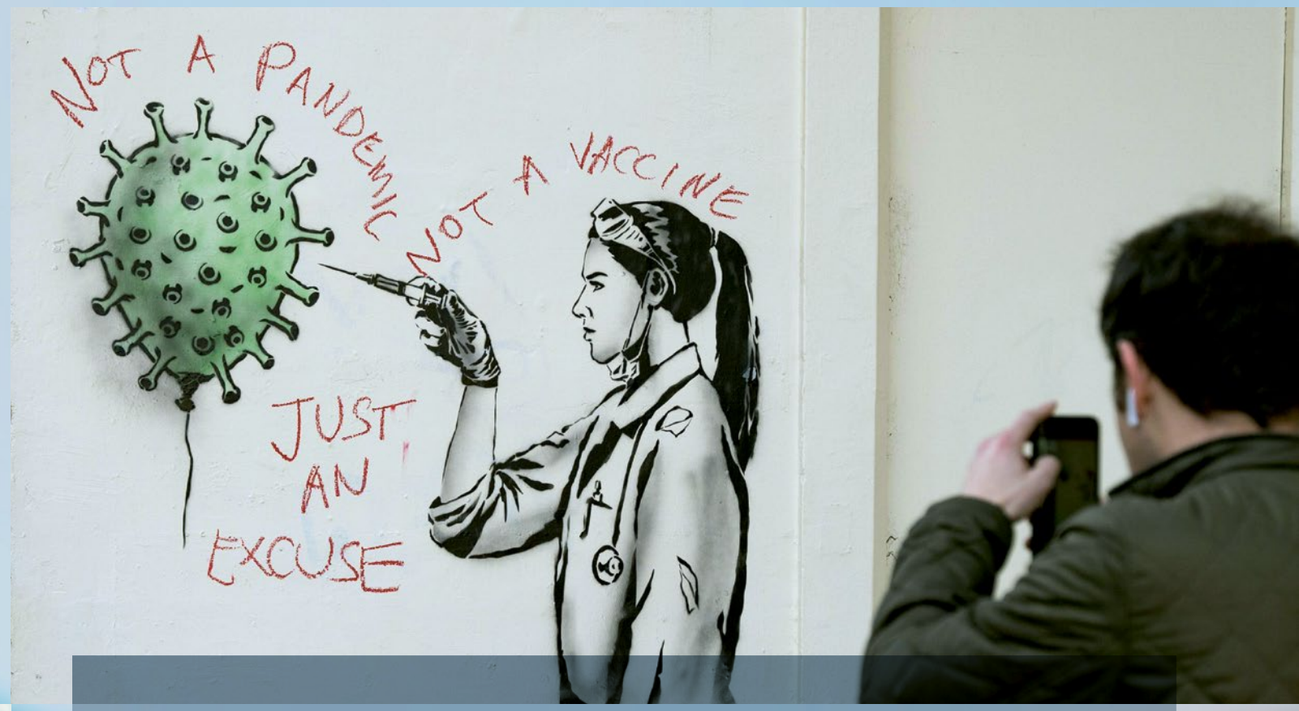


globally: the fear of potential disease and the fear of potential side-effects of the vaccine. When the disease is present in the near or wider community, parental fear of a vaccine is weaker, and vice versa: parents are scared of a vaccine when they cannot imagine or witness how dangerous vaccine-preventable diseases are. This is a costly and short-term 'solution' for vaccination reach.

The parental caring position is straightforwardly exploited by the presence of rumours and threatening campaigns led by the blatant anti-vaccination billion-dollar industry, which propagates malign intentions of 'the vaccine'.

Parents are the key propagators of vaccine hesitancy and consumers of anti-vaccine influences, while the children are the key victims. In extreme cases, which are represented by a small percentage of the population (less than 5% on average), it is the position of complete refusal of the vaccination, and a phenomenon labelled as intensive parenting, which is considered to be one of the most dominant parenting styles in the current neoliberal societies. Parents feel that children's outcomes (intellectual, social, emotional and health-related) and protection are solely parental responsibility, and research shows that intensive parenting has been an important rationale for refusing vaccines, as salutogenic parents have a higher sense of advocacy and feel more capable of taking care of the children without expert scientific intervention, government or vaccines. However, this is a small minority of parents encapsulated in specific communities, while approximately 20%–40% of parents are hesitant, or – simply put – confused.

Parents are the key propagators of vaccine hesitancy and consumers of anti-vaccine influences



What is a no-brainer for science is an in-depth decision for parents

In short, what is a no-brainer for science is an in-depth decision for parents. Scientific and parental stances differ in many aspects: epistemologically, in statistical reasoning, psychological and emotional involvement, socially and in their perception regarding the dangers of vaccines. These aspects collide in the media arena, in which some of the arguments used by the establishment are that parents are no good in statistical reasoning and irresponsible in risk assessment, that they are naive to believe everything they read on the internet, that they should not be 'burdened' by the complicated mechanism of vaccination. This poses a problem for several reasons, but mostly because discarding parental concerns widens the gap between those two stances and undermines the key factor that makes a group of humans a community: trust. Secondly, parents are more scientifically literate nowadays than a few decades ago, and also hyperconnected globally. Thirdly, the internet is the reality and real source of information, even when providing lies. Fourthly, parents are not ever going to have an 'easy-going' approach toward any health-related decision regarding their child. All of these combined posit fundamentally different and new challenges for parents and stakeholders who are communicating with them. Stating that parental fear is not scientifically justified or just merely fighting misinformation (though necessary) is futile, since the concerns regarding vaccination are not coming from science at all. Instead, providing comprehensive, both informational and emotional, support for adequately informed parental decisions about life-saving vaccines will contribute to the sustainable discourse about vaccination. After all, one common ground for both the scientific and parental stances is for children to be immune and safe.

A paediatrician's perspective

Parental decisions about vaccination: our children's health

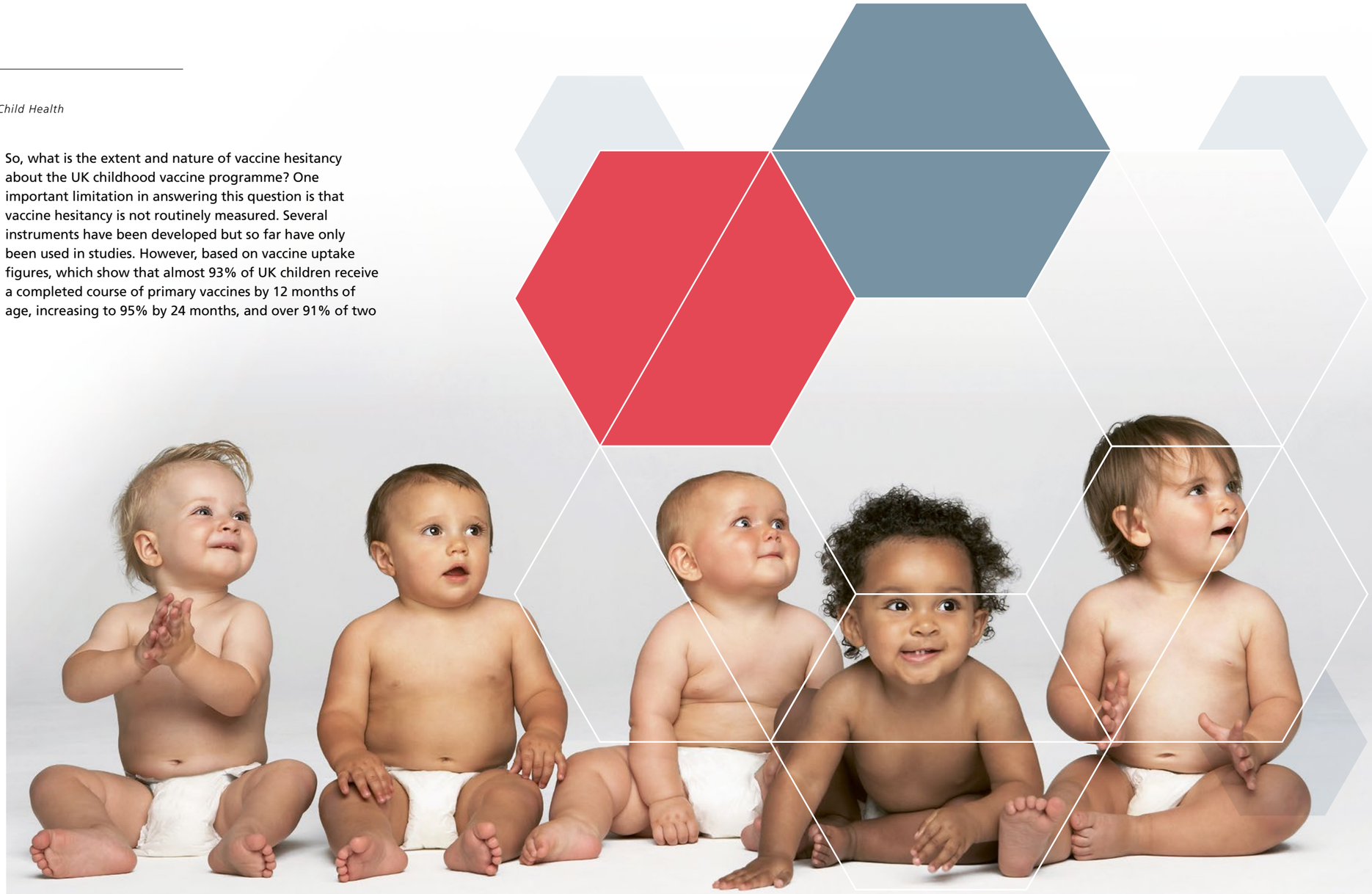
Helen Bedford

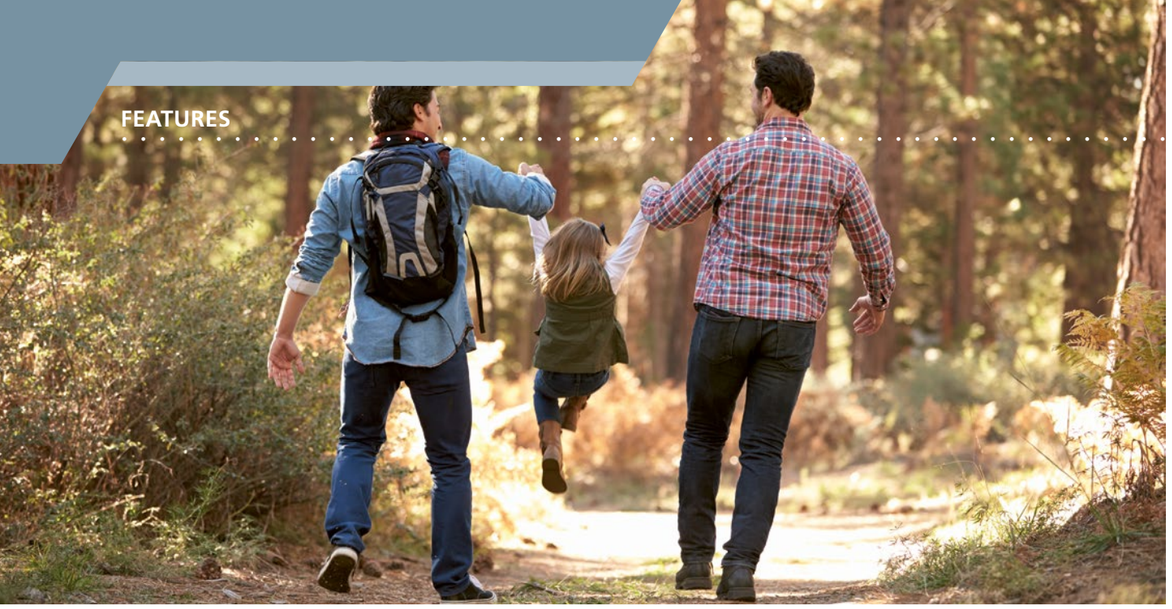
Professor of Children's Health, UCL Great Ormond Street Institute of Child Health

Vaccine hesitancy is a relatively new term for a phenomenon that is as old as vaccination itself. Defined by the World Health Organization (WHO) as 'delay in acceptance or refusal of vaccination despite availability of vaccination services', importantly it is '… complex and context specific varying across time, place and vaccines'. Although this definition includes issues such as availability of and access to vaccines, in practice the term has become used to describe the expression of concerns and questions about vaccination. As the COVID-19 vaccination programme is being rolled out, it is an issue attracting much discussion in mainstream media due to concerns that vaccine acceptance or intention to be vaccinated among some groups is less than optimal. It has been suggested that vaccine hesitancy is increasing, which in view of the proven value of vaccination is a great concern. Indeed, in 2019, the WHO identified vaccine hesitancy to be 1 of 10 threats to global health.

93% of UK children receive a completed course of primary vaccines by 12 months of age

So, what is the extent and nature of vaccine hesitancy about the UK childhood vaccine programme? One important limitation in answering this question is that vaccine hesitancy is not routinely measured. Several instruments have been developed but so far have only been used in studies. However, based on vaccine uptake figures, which show that almost 93% of UK children receive a completed course of primary vaccines by 12 months of age, increasing to 95% by 24 months, and over 91% of two year olds receive a first dose of the MMR vaccine, increasing to 95% by five years, vaccine hesitancy seems to be low. This is supported by regular Public Health England surveys of parents of young children, in which over 90% of parents report automatically having their children vaccinated when due. So, turning this on its head, vaccine confidence seems to be high in the UK. However, it is also important to recognise that vaccine acceptance is not polarised into acceptance or refusal, rather it is on a continuum with some parents accepting vaccines while still having varying degrees of doubt and needing reassurance or further information from healthcare providers. We must not assume that a vaccinating parent has no questions or concerns. Only a small proportion of parents, about 1%–2%, actually refuse all vaccines and it is a tiny proportion of the population who have the extreme views that can be considered 'anti-vaxx'. Although this term is used liberally, particularly by the media, it is inaccurate and may be taken as insulting to most parents who voice concerns about vaccines to call them anti-vaxx. The power of the anti-vaxx movement is its loud voice and reach rather than its size, but for parents with genuine concerns it may be influential.





Importantly, although overall childhood vaccine uptake is very high, it varies between and within districts, with the lowest uptake in the UK in London. Where immunisation uptake is sub-optimal, it is obviously important to determine the reasons for this, rather than making assumptions. In a classic example, uptake of vaccination was noted to be poor among an orthodox Jewish community in north London with resultant regular outbreaks of measles. It had been suggested that parental religious beliefs might be among key reasons for this under-immunisation. A detailed investigation revealed that although parents in this community had concerns about vaccines, they were similar to those of the wider population relating to vaccine safety or concerns about 'vaccine overload'. A major barrier to vaccination for this community, where family size is often significantly larger than average, was the difficulty making vaccination appointments, and long waiting times with a number of young children in an environment that was not family friendly, often cramped and with nowhere to leave prams.

Research consistently shows that low vaccine uptake in the UK is associated with large family size, lone parents, mobile families, children having chronic or disabling health conditions for whom accessing services may be difficult or not prioritised for practical or logistical reasons. Ensuring high vaccine uptake thus requires a combination of the provision of well-organised, flexible, culturally appropriate and family-friendly services, an ensured vaccine supply, information systems to monitor uptake as well as to facilitate a reminder and recall system for parents. Well-informed, enthusiastic health professionals, who are able to respond appropriately and effectively to parents' questions and concerns, can do much to provide reassurance and allay any fears over vaccination. Key to this is that parents tend to follow the advice of those they trust. Trust can be developed or increased through vaccine conversations in which parents are listened to, taken seriously and responded to openly and honestly. This is an important part of an effective vaccination service, particularly now with easy access to mis- and dis-information on social media.

Understandably, people have always hesitated over vaccination due to safety concerns; during the whole-cell pertussis vaccine safety scare in the 1970s and MMR vaccine controversy in the 1990s/2000s, these became heightened, and concerns about the latter still persist to some extent. More recent additions to these are concerns about vaccine content such as aluminium and formaldehyde, animal-derived content or multiple vaccines overloading the immune system. The success of the vaccination programme, with vanishingly rare incidence of disease may contribute to enabling these to take hold. Balancing the risks of disease against the risks of vaccine (albeit very small) becomes difficult in the virtual absence of disease. However, even in the midst of a pandemic where vaccination represents the only viable way out, fears over the speed of development of COVID-19 vaccines using new technologies is causing some to question their safety and to hesitate over vaccination.

Although the childhood vaccine programme in the UK is very successful with generally high uptakes there is no room for complacency and considerable room for improving uptake in some parts of the country and with some vaccines. While there is still a need to identify effective interventions to address vaccine hesitancy, improving access using established evidence-based good practice would go a long way to closing the immunisation uptake gap.

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NEW MEMBERS OF THE SOCIETY MARCH 2021

Bangladesh
S K Sanyal

Cyprus
D Apostolou

Nepal
P Dawad

Netherlands
B Hermanns
D Spijkerman
N van der Burgt
S Barendse
R van Beek

Nigeria
O Florence
O Taylor
C Esuola

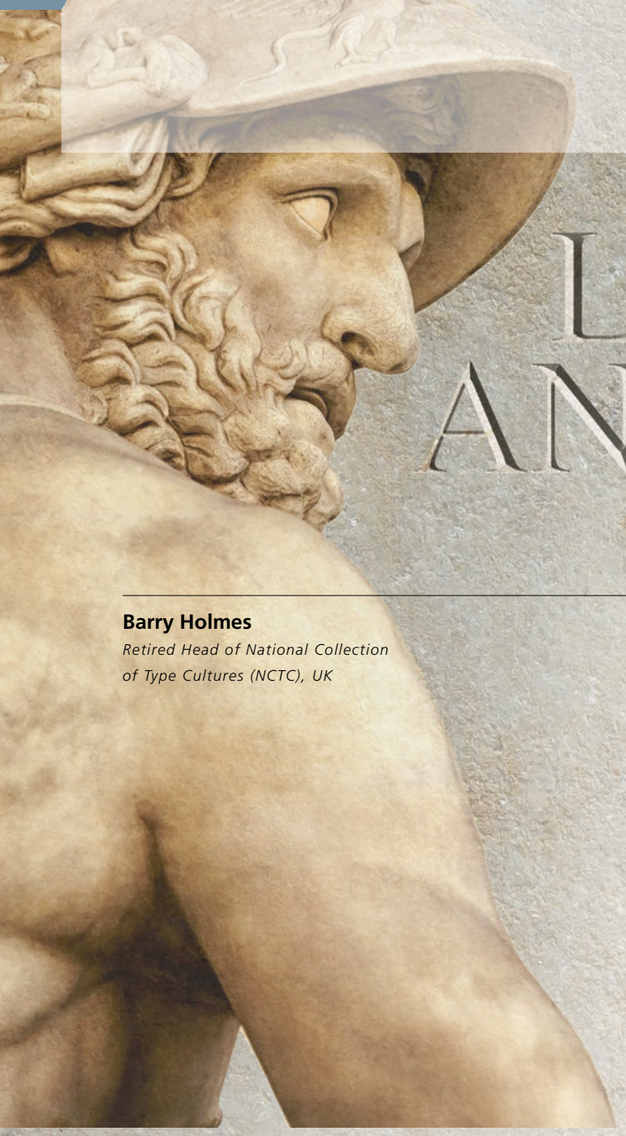
Oman
O Barakat

Portugal
P C Ayogu

United Kingdom
A Ojiogu
A Boydell
E Csibra
N Bean
C Roughton
A Lacatusu
H Trivett
T Page
H Rees
A Asare
S Shaikh
O C Anika
E Prentice
S Szymoniak
M Solsona
M R Domingo Sananes
H Shah
P O Adkin
A Adekola
M Edwards
C Maryan
M El Mohtadi
S Kelly
E Hetherington

United States
Q Wang

Uruguay
C Maria Jose Gonzalez



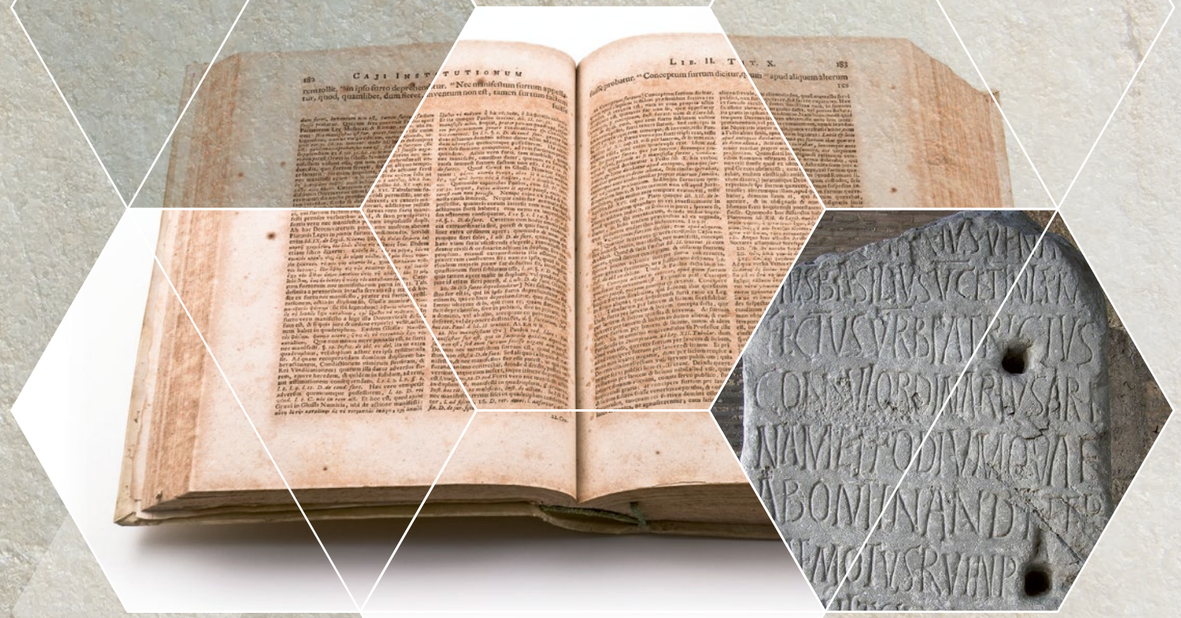
LATIN ANYONE?

Barry Holmes
Retired Head of National Collection of Type Cultures (NCTC), UK

In biology, we are well acquainted with evolution and ultimately, the extinction of some species. In a similar way, languages have also evolved and we witness divergent evolution due to geographical isolation. Portuguese and Spanish as spoken in South America now differ from that spoken in Portugal and Spain, respectively. American English has diverged from classical English, in spellings, 'thru' instead of 'through', and even in meaning; for us in the UK a subway is a tunnel by which we can cross under a road, in the USA it means an underground railway system. Many languages have become extinct and some nearly so, as with Latin.

Education has also evolved and at the time I went to school I had the choice to study Latin, now rarely offered as a subject. In some ways I felt I should have learned a more modern language, like Spanish. However, Latin, whether we continue to be aware of it or not, is the basis of many words in French, Italian, Portuguese, Romanian and Spanish, which have similar origins (Romance languages), but also in English (perhaps up to 60%), despite its West Germanic origins, thanks to the Roman occupation. A knowledge of Latin enables us to both understand the origins of some words in our own English language but also to recognise the origins of many words in other Latin-influenced languages. In English, for example, we continue to use the terms ad hoc [when necessary or needed (adverb); created or done for a particular purpose as necessary (adjective)], ad nauseam (to talk about a subject for so long it becomes tiring) and vice versa (conversely), whilst we commonly use 'etc.', an abbreviation of *et cetera*. In the science field we are acquainted with 'et al.' – the appropriate abbreviation for *et alia* (and others). Nectar derives from exactly the same word *nectar* in Latin. Astrology and astronomy are derived from the Latin for a star, *astrum* (plural *astra*), nebula and nebuliser are derived from the Latin *nebula*, meaning mist. In other cases the Latin origin is less clear; in Latin, *plumbum* is the word for lead, thus a person who worked with lead became known as a plumber and until more recent times water used to be delivered throughout the home in lead pipes. From the Latin *amicus* for friend are derived 'amicable' in English, 'ami' in French, 'amico' in Italian, 'amigo' in Portuguese and Spanish, and 'amic' in Romanian. From the Latin *libertas* for freedom are derived 'liberty' in English, 'liberté' in French, 'libertà' in Italian, 'liberdade' in Portuguese, 'libertad' in Spanish and 'liberty' in Romanian.

In bacterial nomenclature, names are Latin or Latinised words and such names are usually printed in italics (or underlined in manuscripts). The names of all taxa are Latin or Latinised words treated as Latin, regardless of their origin. An example taken from LPSN – the List of Prokaryotic names with Standing in Nomenclature (**https://www.bacterio.net/**) is *Aeromonas salmonicida*, for which the etymology is given as: L. n. *salmo -onis*, salmon; L. suff. *-cida*, murderer, killer; from L. v. *caedo*, to cut or kill; N.L. n. *salmonicida*, salmon-killer. So the species epithet is derived from a Latin noun, a Latin suffix and a Latin verb to make effectively a new Latin word; here the N.L. stands for Neo-Latin (a word treated and used as a Latin word). A further example, with a part derivation from Greek is the genus *Pseudomonas*, whose etymology is given as Gr. masc./fem. Adj. *pseudês*, false; L. fem. n. *monas*, a unit, monad; N.L. fem. n. *Pseudomonas*, false monad, based on a Greek adjective and a Latin noun. Similar rules may be found in the International Code of Nomenclature for algae, fungi and plants (**https://www.iapt-taxon.org/nomen/main.php**) and the International Code of Zoological Nomenclature



FEATURES

(**https://code.iczn.org/**). In medical terms too we see Latin origins: cartilage from *cartilago*, the Latin for gristle; and cutaneous from *cutis*, the Latin for skin.

In bacteriology, new names are proposals and their use is not mandatory. Any name published in the *International Journal of Systemic and Evolutionary Microbiology* (IJSEM) and in accordance with the *International Code of Nomenclature of Prokaryotes* (ICNP, formerly the *Bacteriological Code*) is validly published. There is thus no such thing as a 'correct name' for a bacterium; all validly published names are 'correct' and one need not meekly accept the latest proposal as soon it is published. Although it is generally advisable to adopt new names and to keep abreast of nomenclatural changes it is ultimately the scientific community that determines whether a new name comes into general acceptance; it is not automatic. In a similar vein, language usage is ultimately determined by what society generally accepts or deems to be correct. Just as more than one name can be used for a single bacterium, so different endings of a single plural become acceptable. Thus, as an example, people can choose between the Latin plural 'hippopotami' or the anglicised version 'hippopotamuses', as both may be found in dictionaries. So will we see the acceptance of 'funguses' as well as 'fungi' as alternative plural forms in years to come? At least here we are just considering words appreciated to have a pluralised form.

Some claim educational standards are higher in the northern UK than in the south.

PHOTO COURTESY OF CHARLES HUBBARD

In bacteriology, new names are proposals and their use is not mandatory

Whilst knowledge and use of Latin lives on in the medical and scientific fields, here too we see forgetfulness of Latin roots, particularly a lack of appreciation of words having both plural and singular forms. For example, the Latin *medius* means middle or intermediate, something which facilitates achieving something, whether communication or microbial growth. Thus the internet is a medium, so is a newspaper, so is radio and so is television, but collectively they are the media – plural, communicating knowledge to us (we may commonly but erroneously think of a medium only as a person who facilitates communication with the spirit world). Similarly, each of blood agar, MacConkey agar and nutrient agar is a medium but they are all media – plural, allowing us to grow bacteria. In a similar vein, the Latin word *datum*, literally 'given' has come to mean a single piece of information, fact or statistic. In English usage we rarely use the singular term datum (in the UK an ordnance datum is a vertical datum used by an Ordnance Survey as the basis for deriving altitudes on maps); we most commonly use multiple pieces of information – data, plural. Yet this is so often forgotten these days. We see odd evolutionary trends in the English language, driven by a lack of knowledge; witness the widespread use of the meaningless apostrophe in plurals in recent years (as in chip's and video's). This lack of knowledge is also driving an acceptance of plurals as singular (especially in American English), or at least confusion as to which is plural and which singular. In the *Biologist* in 2020 have been printed 'a sulphur-reducing bacteria' and 'in which bacteria is cultured'; elsewhere have appeared 'meet this criteria'; 'latest data is'; 'that data was'; 'your data is'; 'social media has' etc. If you have read this article then you no longer lack the knowledge of our Latin roots and can therefore reflect them in your own writings if you so choose. Some common words used in science with their singular and Latin plurals are given in the table below. *Pax vobiscum*! (Peace be with you!)

SINGULAR	PLURAL
alga	algae
amoeba	amoebae
formula	formulae
larva	larvae
nebula	nebulae
pupa	pupae
vertebra	vertebrae
foramen	foramina
index	indices
analysis	analyses
axis	axes
basis	bases
crisis	crises
hypothesis	hypotheses
parenthesis	parentheses
synthesis	syntheses
matrix	matrices
criterion	criteria
phenomenon	phenomena
taxon	taxa
aquarium	aquaria
bacterium	bacteria
datum	data
forum	fora
gymnasium	gymnasia
medium	media
millennium	millennia
stadium	stadia
stratum	strata
symposium	symposia
alveolus	alveoli
cactus	cacti
crocus	croci
focus	foci
fungus	fungi
nucleus	nuclei
octopus	octopi
radius	radii
stimulus	stimuli

AMR: an unseen threat in the race against COVID-19

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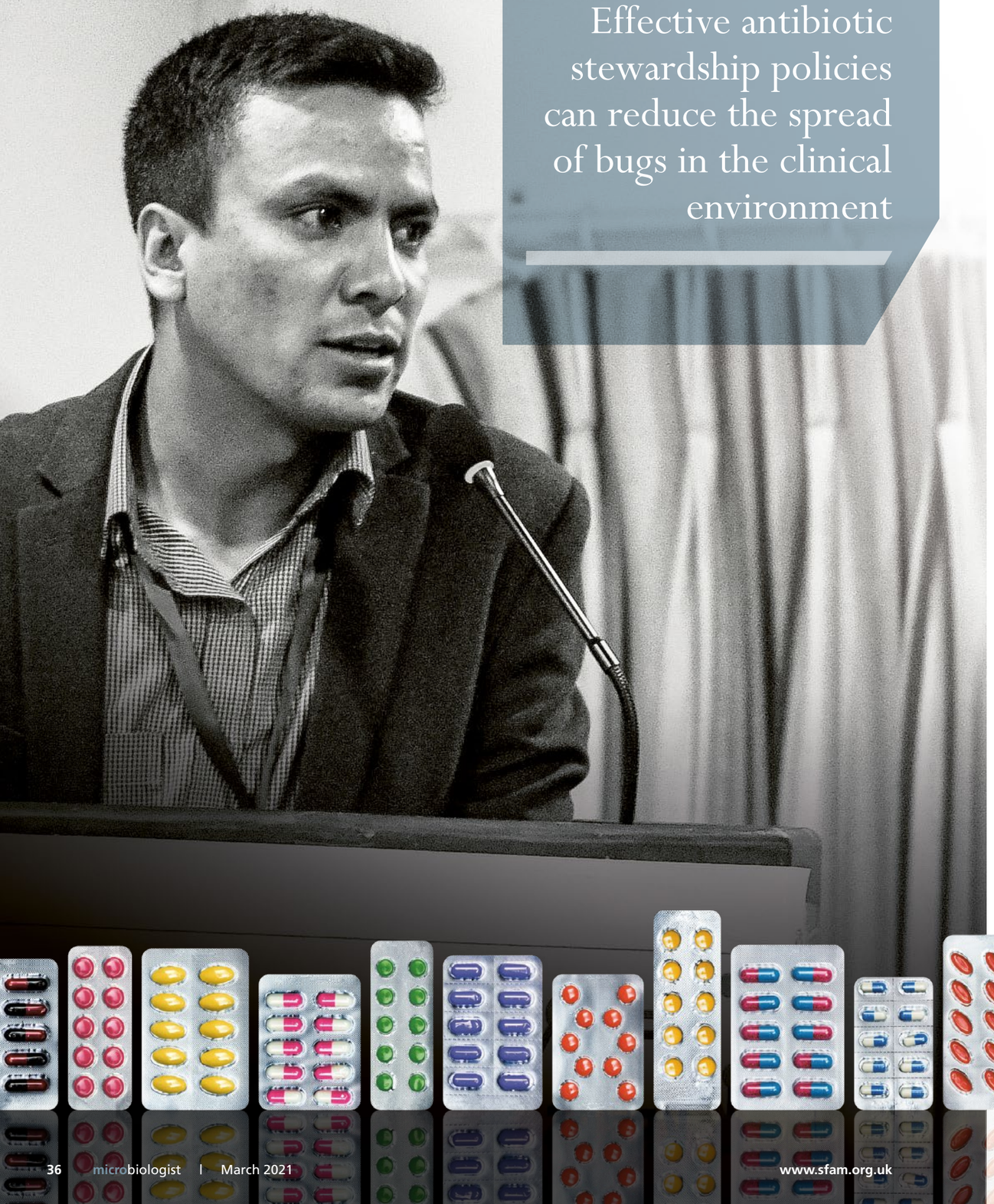
UNSW, Sydney, Australia
Kathmandu Research Institute for Biological Sciences (KRIBS), Lalitpur, Nepal

Nearly the entire living population of Earth is being threatened by the COVID-19 pandemic, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Large numbers of people are still losing their lives every day and COVID-19 is the most challenging public health crisis of our generation since World War II. Since the first case of SARS-CoV-2 was reported in Wuhan, China, in late 2019, the virus has reached all territories around the world, even Antarctica. Due to the lack of definitive drug therapy for COVID-19, management of patients in clinical settings has been challenging. Global efforts of all concerned stakeholders and researchers are in place in an attempt to combat this threat.

Amid this pandemic, we shouldn't forget about another major issue in this era of modern medicine – antimicrobial resistance (AMR) – but global attention is currently more focused on COVID-19 than on AMR. Antibiotics, crucial life-saving medicines, were 'miracle drugs' of the 20th century but are now becoming less effective in treating infections caused by some pathogens. Microbes (bacteria, parasites, viruses or fungi) that develop AMR, also known as 'superbugs', are creating a global problem albeit with varying rates of resistance in different countries. If the development of AMR were to continue at the same rate then it has been estimated it could be responsible for the deaths of nearly 10 million people annually worldwide by 2050 and for a decrease of 2%–3.5% in gross domestic product (GDP), which would cost the world about 100 trillion US dollars. AMR develops more slowly than COVID-19 but the efficacy of antibiotics is falling and threatening some aspects of modern medicine.

Because of COVID-19 more immunocompromised patients are being hospitalised, enabling resistant pathogens to circulate widely in this vulnerable population. Some COVID-19 patients are suffering from secondary bacterial infections associated with pneumonia, fever, cough and diarrhoea, among others. Studies have reported that the rate of secondary infections has sharply increased among hospitalised COVID-19 patients, which has increased disease severity and the length of hospital stay. More than 50% of COVID-19 deaths are because of secondary bacterial infection. Bacteria like *Streptococcus pneumoniae* can worsen viral infections like COVID-19 and influenza; secondary bacterial infections heavily increased patient mortality in earlier viral pandemics such as the 1918 and 2009 influenza pandemics. A viral infection can weaken

Nearly the entire living population of Earth is being threatened by the COVID-19 pandemic



Effective antibiotic stewardship policies can reduce the spread of bugs in the clinical environment

the immune system, which can lead to drug-resistant bacterial infections. Published data suggest that more than 90% of COVID-19 patients are receiving antibacterial treatment at some point during the course of their infection. Overuse and widespread use of antibiotics can increase the resistance rate of pathogens. Also, the extensive use of disinfectants and antibacterial soaps can accelerate drug resistance mechanisms in microbes.

However, different studies are underway to better monitor the types and quantities of antibiotics being used for the treatment of COVID-19 patients, to address the pressing need for a standard protocol for the medication strategy of COVID-19 patients. Overuse of antibiotics can lead to selective pressure on bacteria to develop resistance against the antibiotics being used, so increasing the spread and prevalence of drug-resistant infections.

The rise in AMR is ringing alarm bells so researchers are investigating different approaches to counteract the pathogens such as phage therapy (bacteriophages are viruses that infect bacteria) and the use of antimicrobial peptides. Effective antibiotic stewardship policies can reduce the spread of bugs in the clinical environment. Discouraging the prescription of antibiotics for viral diseases, increasing awareness among people towards rational use of antibiotics, delaying the prescription of antimicrobial drugs until after antibiotic susceptibility testing and promoting good health hygiene practices in healthcare systems will help to reduce the burden of AMR globally. Despite all of the medical advances of recent decades, the world's population remains susceptible to COVID-19 infection while we don't have an approved drug for its treatment so we have to learn a big lesson from SARS-CoV-2. As per statements of healthcare experts, disease pandemics are an inevitable phenomenon of nature, which can happen any time at any place, but we can mitigate the risk factors associated with disease pandemics. The global outbreak of SARS-CoV-2 has shown the real power of invisible pathogens so all scientific communities should be united globally to enhance and develop better and effective drugs and diagnostic tools. We can't be sure where and when the next pandemic will occur but it is certain that AMR microbes will be there, even in more complex and deadlier forms. In the context of a widening gap between superbugs and drugs on hand to treat them, the demand for new antibiotics is a pressing need of today and days to come.

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The global diversity of the plastisphere

Robyn Wright
Dalhousie University, Canada

Plastics are undoubtedly some of the most versatile and useful materials ever produced, but – when not managed effectively – plastic waste is a major environmental issue. An estimated 7 billion tons of plastic waste have now been produced globally, 79% of which has been discarded in landfills or the environment. There are a range of routes for plastic to end up in the environment, such as mismanagement of waste, lost or discarded fishing gear, fibres released during the washing of clothes or microplastics in cosmetic products, and currently between 19 and 23 million tons of plastics are predicted to enter the oceans annually. Once in the oceans, these plastics experience a range of biotic and abiotic processes; they can be transported long distances by wind and currents, they may be fragmented by wave action, or undergo weathering through processes such as UV photodegradation and they can cause a range of negative environmental impacts, both directly, through entanglement or ingestion, or indirectly, through the transfer of toxic chemicals. Although the ultimate fate and durability of plastics is unknown, some suggest a persistence of hundreds of years or fragmentation rates as low as 1%–5% per year. This has led us increasingly to look towards microbes for a solution to this problem.

As with any surface that enters aquatic environments, plastics are rapidly colonised by living organisms. These are typically microbial communities that are composed of diverse bacteria, single-celled algae and fungi, but can also include macroorganisms such as barnacles, bryozoans, hydroids or multicellular algae. Collectively, these biofilms have been termed the 'plastisphere'. There are now over 100 marine plastisphere studies, which have used a range of experimental and methodological conditions to characterise the plastisphere, and microbial members of the plastisphere have been suggested to be: (i) different from communities that colonise other surfaces (or from surrounding free-living communities); (ii) not different from communities that colonise other surfaces; (iii) only different from communities colonising other surfaces under specific environmental conditions or at specific time points; (iv) more diverse than other microbial communities; (v) less diverse than other microbial communities; (vi) potentially degrading the plastics; (vii) potentially degrading the additives of plastics or (viii) pathogenic and/or carrying antimicrobial resistance genes. So how do we know which of these are 'true', or under which circumstances they occur?

All of the studies that use next-generation sequencing to characterise the plastisphere are theoretically comparable; however, the different methods that they use for data analysis mean that they are not directly comparable. With the aims of investigating the environmental and methodological factors that shape the plastisphere, as well as whether potential plastic degraders or pathogens are present within the plastisphere, we collected all of the marine plastisphere studies that had available sequencing and metadata (at the beginning of 2020). This meant that we were able to perform a meta-analysis that included 21 marine studies and almost 1200 samples that characterised the 16S rRNA gene using amplicon sequencing (as well as a further 14 studies carried out in freshwater, other aquatic or terrestrial environments). Most of these studies collect plastics after unknown environmental residence times, are conducted around Europe or in other temperate environments, there were no studies carried out in the Southern Hemisphere, many studies don't determine plastic type or include biofilm controls (e.g. rocks, glass or shells), and there were very few studies that characterised 18S or ITS2 rRNA genes or used shotgun metagenomics.

FEATURES

As with any surface that enters aquatic environments, plastics are rapidly colonised by living organisms

We found that samples from the same study or environment were the most similar to one another, with the Proteobacteria almost always dominating in terms of relative abundance. We used random forest models (machine learning) on 20 metadata categories to show that overall environmental variables have the largest impact on shaping the plastisphere. The top five variables were: (i) light availability (ambient or modified); (ii) whether experiments were carried out in the laboratory or in the field; (iii) whether plastics were incubated in the water column or the sediment; (iv) the environment that the study was performed in and (v) the primer pair that was used for sequencing.

While plastic type (to varying levels of specificity) did not produce accurate random forest models when samples from all environments were considered together, when we split samples to the environment that they were from we found that the community composition could be used to accurately predict the general plastic type up to 83% of the time in the marine environment. We found that many of the taxa that were most informative for building these models, and that were also more abundant on plastics than control biofilms across the included studies, were from hydrocarbonoclastic, or hydrocarbon-degrading, groups. In particular, the Oceanospirillales were more abundant on aliphatic plastics (polyethylene or polypropylene) and the Alteromonadales were more abundant on other plastics (e.g. polyethylene terephthalate or polystyrene). These are taxa that have been suggested previously to be degrading plastics or the additives of plastics but are also known to be capable of degrading substrates that share structural similarity with plastics (as well as the additives of plastics) like alkanes or components of crude oil.

There were also several taxa that were more abundant on plastics than other substrates that are potentially pathogenic; however, there are limits to what we can establish solely based on the taxonomic information gained from sequencing of the 16S rRNA gene. The ability of a bacterium to be pathogenic is likely dependent on the presence of specific virulence factors that are often in mobile genetic elements. Furthermore, the amplicon sequencing used by most plastisphere studies to date does not give the resolution to differentiate between closely related strains of the same species, such as between pathogenic and non-pathogenic *Vibrio* species or hydrocarbon-degrading and non-degrading *Pseudomonas putida* strains. These results confirmed that general principles in marine microbial ecology govern the colonisation dynamics of plastics but highlighted the need for further work that characterises the functional capacity of the plastisphere.

It is clear that plastics are not going anywhere any time soon, and the potential for them to be degraded by environmental microbes has captured the imaginations of scientists and members of the public alike. Whilst some studies have shown promising results on the biodegradation of plastics by isolated microorganisms in laboratory studies, there is still much work to be done before we can definitively determine what happens in the environment.

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Functional diversity of microboring *Ostreobium* algae isolated from corals.

Massé A, Tribollet A, Meziane T, Bourguet-Kondracki ML, Yéprémian C, Sève C, Thiney N, Longeon A, Couté A, Domart-Coulon I. Functional diversity of microboring *Ostreobium* algae isolated from corals. *Environmental Microbiology* 2020; 22(11), 4825–4846.

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The filamentous green alga *Ostreobium* sp. (Ulvophyceae, Bryopsidales) actively dissolves shallow-water carbonates and constitutes a cryptic yet essential functional component of marine ecosystems. Indeed, this microscopic alga dominates microboring communities in carbonate skeletons of reef-building corals, and is one of the major agents of carbonate dissolution at reef-scale. *Ostreobium* lives mainly as the bioeroding form (eu-endolithic), but free-living filaments (or propagules) can be found in seawater or benthic biofilms. This last decade, a high genetic diversity of *Ostreobium* was revealed in living corals, however, with unexplored functional diversity. Specifically, it wasn't clear to what extent the phenotypic traits of *Ostreobium* algae varied with genotype and growth habitat.

The Massé *et al*. 2020 study provides experimental evidence of the phenotypic heterogeneity of nine new *Ostreobium* algal strains affiliated to two *rbc*L genetic lineages (one of which was affiliated to the Odoaceae family), depending on their growth habit as bioeroding (eu-endolithic) versus free-living filaments. Changes in chlorophyll content, fatty acid composition and stable isotope values were recorded, together with differential uptake of dissolved inorganic carbon and nitrate, quantified with isotopically labelled tracers. Physiological adaptations to life in dense carbonate habitats are presented in a conceptual model, which summarises the mechanisms of carbon and nitrogen acquisition by *Ostreobium*. Mixed sources of C and N are proposed, mainly from seawater-dissolved inorganic carbon and nitrogen, which may be combined with organic matter originating from the coral skeletal organic matrix and bacterial and fungal associates (or both), and hypothetical use (in dissolved inorganic carbon (DIC)-limited conditions) of some carbon released by coral skeletal dissolution. These novel findings on the diet of cryptic *Ostreobium* algae have implications for carbon and nitrogen cycling in the coral holobiont and carbonate reef ecosystems.

Isabelle Domart-Coulon
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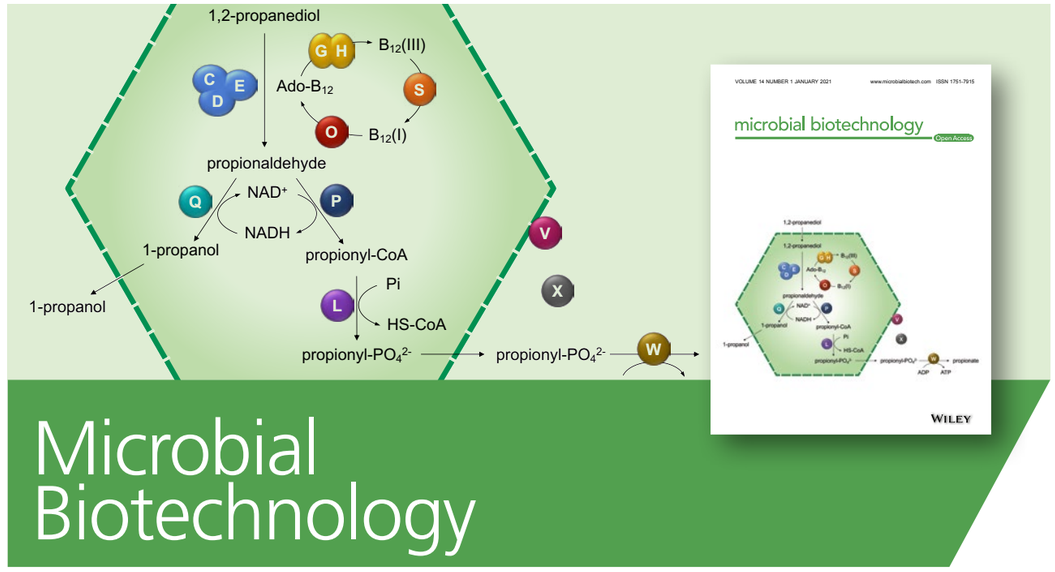

Bacillus subtilis as a host for mosquitocidal toxins production.

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Mosquito-borne diseases are endemic in different areas of South America, Africa and Asia. The rapid and global spread of vector species such as *Aedes aegypti* and *Aedes albopictus* represents a major risk for their diffusion in Europe also. As these diseases cannot yet be prevented by vaccination, vector control represents the most valuable strategy to avoid their diffusion. In this context, the use of biological insecticides is taking ground as a field of great interest.

Biological control of mosquito populations mainly relies on the use of *Bacillus thuringiensis* subsp. *israelensis* (Bti), a Gram-positive bacterium able to synthesise larvicidal proteins that are produced during sporulation as parasporal inclusions. The need to implement the arsenal of biological insecticides requires the search for new bacterial strains and toxins with larvicidal activity against mosquito vector populations. However, environmental isolates can be difficult to grow and genetically manipulate, hampering the characterisation of newly identified toxins.

To overcome these limitations, in this work, Ursino and collaborators propose to use *Bacillus subtilis* as a host for the expression of entomopathogenic toxins. Taking advantage of the deep knowledge of the genetics of this bacterium and of well-established tools for its manipulation, the authors set up different inducible and auto-inducible expression systems that allowed investigation of the activity of individual or combinations of Bti toxins. *B. subtilis* strains expressing one or more toxin genes of Bti were created and tested for their toxicity towards larvae of *A. albopictus*.

The presented systems can be used to characterise individual toxin genes of new environmental isolates and to test combinations of toxins from different mosquitocidal bacteria. Therefore, these results set the basis for the development of *B. subtilis* strains useful not only for genetic studies but also for environmental biotechnological applications.

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Giulia Barbieri
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An interview with Dr Joan Geoghegan

Senior Lecturer in Microbiology and Infection at the Institute of Microbiology and Infection, University of Birmingham

The WH Pierce Prize is one of SfAM's most prestigious prizes, awarded to a young scientist who has made outstanding contributions to the field of microbiology. The 2020 WH Pierce Prize was awarded to Dr Joan Geoghegan, Senior Lecturer in Microbiology and Infection at the Institute of Microbiology and Infection, University of Birmingham. Dr Geoghegan's work has focused on the mechanisms of *Staphylococcus aureus* colonisation and infection, as well as identifying targets for treatments against this pathogen.

SfAM's Dr Paul Sainsbury caught up with Joan to get an insight into the person behind the research.

Who are your microbiology heroes?

Reading about the work of Louis Pasteur captured my interest at an early age. Pasteur's discoveries about the role of microorganisms in fermentation, food spoilage and disease were instrumental in fostering an appreciation of the microbial world, giving rise to the discipline of microbiology. Pasteur's ambition to identify the cause of disease and to develop new ways to prevent disease and to save lives inspires my own research goal to understand how bacteria establish infection and to use this information to prevent and treat infection. Modern-day heroes are too numerous to mention and I continue to be in awe of many inspiring microbiologists who are carrying out fantastic science!

What is your proudest moment as a scientist?

A real standout moment for me was winning the prize for best oral presentation at a Gordon Research Conference in 2009 while I was a postdoc. This was my first oral presentation at a conference and being chosen to speak at this prestigious meeting and winning this prize was a major achievement for me and a very proud moment. More recently, I am incredibly proud of the achievements of my students and postdocs, great and small, over the past 7 years. Establishing my own research group and contributing to the mentoring of the next generation of microbiologists will never stop feeling like a great achievement!

What's the strangest thing you've seen happen in the lab?

Strange things happen in the microbiology lab all the time! From unusual contaminants to unexpected findings, sometimes the strangest things we see are the most interesting and the most important. An unusual species growing from a clinical sample or a strange colony morphology often cause you to stop and evaluate your hypothesis and (if you're lucky) can even herald new unexpected discoveries!

Where in the world has microbiology taken you?

I've been lucky enough to travel quite widely within Europe and North America. The opportunity to discuss research and to exchange ideas with other scientists is a really enjoyable part of science. I can also count many friends I've made along the way, many interesting places I've had the opportunity to visit and new cuisines I've been able to sample. I really enjoyed visiting Tromso, close to the Arctic Circle, but unfortunately the timing was not right to see the Northern Lights!

What's your favourite piece of equipment in the lab?

The humble micropipette! There is not much we can do without it. A reliable, precise micropipette is often your best ally in the molecular microbiology lab.

Have you picked up any new hobbies in lockdown?

I've found myself baking far more than usual. I'm currently challenging myself to be a bit more ambitious by trying out new recipes rather than sticking with tried and tested favourites! I wouldn't say I'm the best baker in town but it's something that I find relaxing and enjoyable.

What's the best piece of advice you've been given?

Without a doubt the best piece of advice I've been given is to collaborate with scientists from other disciplines. This has become invaluable to my own research. Much of our research is interdisciplinary and this encourages us to think more broadly about the research question and to be more ambitious with our goals. Collaboration is so important in modern science and I've been fortunate to collaborate with some really excellent scientists and clinicians. There is so much we can learn from other disciplines.

If the Geoghegan lab had a soundtrack, what song would you choose?

'I am a Scientist' by Guided by Voices fits the bill. The title says it all really!

Careers: best-laid plans…

At the end of September 2019, I retired as Head of Bacteriology at the National Institute for Biological Standards and Control (NIBSC) after 10 years as part of the senior management team. The aim was to seek new challenges and restore a sensible work–life balance by eliminating management responsibilities, leaving more time to think about science. Little did I know how dramatically plans would have changed by the start of 2020.

I began studying bacteriology at the University of Newcastle upon Tyne (Newcastle University) in 1976, where Max Sussman (former SfAM President) would be my undergraduate tutor for the next three years. It was an interesting time to embark on a career in microbiology, given recent developments in genetic engineering. By the late 1970s, nucleotide sequencing methods had also been published and were increasingly being used to characterise bacterial genes. Together with the recent discovery of transposable elements in bacteria, these developments provided a new toolkit for studying bacterial genetics. I remained in Newcastle using many of these molecular tools in my PhD research on the virulence factors of uropathogenic *Escherichia coli*, which was funded by a Luccock scholarship from the university. The project was co-supervised by Steve Parry and Colin Harwood (former editor of *Letters in Applied Microbiology* (LAM). I am indebted to Colin in particular for his continued support and friendship throughout my career.

Ian Feavers
Meetings Secretary, SfAM

In 1982, I moved to the University of Sheffield as a postdoctoral research assistant with Anne Moir, using funding released by her recent appointment as a lecturer in microbiology. Anne had recently cloned the *gerA* locus from *Bacillus subtilis* in a bacteriophage λ vector; our task was to characterise the genes and their expression. With PCR yet to be developed, this largely involved subcloning, transposon mutagenesis and nucleotide sequencing. GerA was the first germination receptor to be sequenced and became the model for other germination receptors in the *Bacillus* genus. The product of a tricistronic operon, it is developmentally regulated as a member of the sigma G regulon along with other genes expressed only in the forespore compartment of sporulating cells. During my time in Sheffield, I attended my first international conference in Asilomar, California, which was followed by a 'mini-sabbatical', allowing me time to work with collaborators at UC Davis and UC Berkeley, as well as explore Yosemite and the Sierra Wilderness.

After four years in Sheffield, it was time to broaden my experience and in 1986 I took a postdoctoral fellowship at the Friedrich Miescher Institute (FMI) in Basel, which was developing innovative ways to study the regulation of eukaryotic genes by hormones. Here, I gained confidence in developing new molecular approaches from scratch and experience of exploring protein–nucleic acid interactions. Our first daughter was born in June 1988 and, while postdoctoral research work on short contracts had been great fun, it was clearly time to find a longer-term role. Deciding I was at heart a microbiologist, the following January I started a five-year tenure-track group leader post in the Division of Bacteriology at NIBSC.

NIBSC principally exists to ensure that vaccines and blood products meet quality specifications, and to provide the standards used to calibrate bioassays. These activities are underpinned by applied research. It had recently moved to new purpose-built laboratories with a substantial budget for new equipment, making it an attractive next step. Fortuitously, Martin Maiden had joined NIBSC a few months earlier and, with our shared interest in applying molecular methods to bacterial problems, we pooled resources to collaborate in research. This was the start of a great friendship and fruitful collaboration that was to last to this day.

We started by applying the latest sequencing methods to investigate the antigenic variation of meningococcal outer membrane proteins because of their importance in vaccine development and typing isolates. The need to put our observations in the wider context of the meningococcal genotypes found in disease and asymptomatic carriage led us to develop multilocus sequencing typing (MLST). Based on this initial development in the meningococcus, today there are MLST schemes for more than 100 microbial species. Our research output enabled us both to fulfil tenure-track requirements, becoming permanent members of staff and senior scientists at NIBSC. In 1997, Martin moved to the University of Oxford as a Wellcome Trust Senior Research Fellow, becoming Professor of Molecular Epidemiology in 2004. We continued to collaborate productively over the ensuing years and continue to publish together to this day.

I remained at NIBSC, as a principal scientist, managing the team responsible for meningococcal and pneumococcal vaccines, which were approved and rolled out from the end of the decade. Because of NIBSC's close relationship with the World Health Organization (WHO), I was seconded to their Geneva headquarters for a few months in the late 1990s to help draft regulatory guidance on these vaccines. In addition, I have participated in a number of WHO missions and training workshops around the world and the team provided regulatory guidance to the WHO/PATH Meningitis Vaccine Project, whose aim was to eliminate meningitis in sub-Saharan Africa. During this time, I was on the editorial board of the *Journal of Applied Microbiology* (JAM), for a while as a co-editor, and served my first term on the Executive Committee (EC) of SfAM.

In 2009, I became Head of Bacteriology and hence a member of senior management. I continued to engage with meningococcal research, thanks to my excellent colleagues in the meningitis team; however, successive rounds of organisational change, increasing bureaucracy and then, after the 2016 referendum, work to mitigate the impact of Brexit, eventually left little time to participate in science. After 10 years in the role, I decided to take my pension and get back to science. Currently, I have an emeritus senior research associate position in the Maiden Group in Oxford and continue to work with WHO as a member of its Expert Committee on Biological Standardisation. The latter has been far busier than anticipated due to the urgent demand for written and physical standards to support developments in the diagnosis, prophylaxis and treatment of COVID-19. I am approaching the end of my second term on the EC of SfAM as Scientific Programmes Secretary but look forward to being part of the SfAMily long into retirement.

I attended my first international conference in Asilomar, California

London's microbiota: gone to the dogs

In 1861 the Victorian writer Charles Stuart Calverley penned a lengthy poem in praise of beer. Readers who persevere as far as lines 57–58 are rewarded with:

O Beer! Oh Hodgson, Guinness, Allsopp, Bass!
Names that should be on every infant's tongue!

Not perhaps a high point in English poetry, but what is remarkable is that some of the names singled out for praise remain familiar 160 years later. Guinness and Bass are both still commonplace and a third, Allsopp, which effectively disappeared in 1959, may yet be resurrected following the brand's acquisition by Brewdog in 2019. That leaves Hodgson, forgotten and unloved, a stranger to the modern reader (and drinker), but a key figure in the emergence of an iconic beer style, India Pale Ale (IPA).

In the 18th century, trade with India was ruthlessly dominated by the East India Company. As a lucrative perk, its ship's commanders were allowed to engage in private trade, carrying freight of their own on the outward voyage to sell on arrival in India; a notable commodity in this trade was beer for thirsty expatriates. Ships bound for India would dock in the Thames at Blackwall, near where it is joined by the River Lea. George Hodgson ran a brewery on the Lea less than two miles away in Bow, by the distinctively shaped bridge that gave the area its name. Proximity and ease of access, coupled with the favourable credit Hodgson offered to ship's officers made him an ideal supplier. The most popular beer of the time, Porter, did not fare well on a sea voyage lasting 3–5 months at temperatures varying between 11°C and 28°C and, even at its best, Porter was probably not the ideal drink for the torrid Tropics. But Hodgson also offered a brew described as October ale, a strong, hoppy, pale beer, traditionally brewed in the autumn for maturation of a year or more before consumption. Because the high levels of ethanol, CO_2 and hop oils presented multiple hurdles to spoilage organisms, the beer had excellent keeping qualities and it was discovered that, unlike Porter, shipments of October ale matured magnificently during the voyage to India to give a sparkling refreshing beer relished by the British population.

Trade in October ale expanded from the late 18th century and took off at the beginning of the 19th when, between 1801 and 1813, Hodgson's contribution quadrupled to 4000 barrels per annum. Some other London breweries participated, such as Barclay who produced an 'India Ale' (as it had become known) from 1799, but Hodgson dominated the market – sufficient for his name to become generic, rather, as in more recent times, Hoover became synonymous with vacuum cleaners and Biro with ballpoint pens.

Unfortunately, George Hodgson and his son Mark, who took over running the brewery around 1810, left much to be desired in their business ethics – trying to cut out the ship's officers and local merchants, lowering prices to drive out competitors and then increasing them later to recoup their losses. This provoked the ire of the East India Company and in 1821 Campbell Marjoribanks, a director and three times chairman of the Company, invited Samuel Allsopp, a Burton-on-Trent brewer, to a dinner at which he promoted the attractions of the Indian market. At the time, the Burton brewers were keen to find a replacement for their export trade to the Baltic, lost as a result of the Napoleonic Wars and the imposition of tariffs by Russia, and though Allsopp's head brewer reputedly spat out a trial batch of the new beer, the first consignment of Allsopp's India Ale was despatched in 1822 and proved a huge success. Its superiority was due to the mineral content of the Burton water, particularly the high levels of calcium, magnesium and sulfate ions; London water though rich in calcium was lower in sulfate. In the brewing process, calcium ions precipitate out as calcium phosphate during mashing, decreasing the pH of the wort; magnesium has a lesser effect on pH but is important in the activity of several yeast enzymes, and sulfate contributes a drier, more bitter flavour to beers. Some brewers such as Ind Coope of Romford responded to this discovery by opening premises in Burton, but from the mid-19th century others found the effect could be replicated simply by adding the mineral gypsum (calcium sulfate) to brewing water: a process known as 'Burtonisation'.

Other Burton brewers such as Bass and Worthington swiftly followed Allsopp, producing their own India pale ales and supplanting Hodgson whose share of the India trade declined rapidly. It was down to less than 7% by 1841 and by 1849 the Hodgson name had disappeared from the Bow brewery.

The new style of pale, bitter beer from Burton became hugely popular at home and abroad – a bottled version, produced by Bass and sporting the first registered UK trademark, the red triangle, can be seen prominently displayed on the eponymous *A Bar at the Folies-Bergère* painted by Édouard Manet in 1882. Shipments of beer from Burton to London increased to such an extent that when WH Barlow designed the train shed for St Pancras railway station in 1868, the undercroft below the platforms was designated primarily as a warehouse for arriving beer. With the station's redesign to accommodate Eurostar in 2007, the undercroft became a shopping area and the Eurostar departure lounge. Today, while waiting for trains to the continent, travellers can muse on the fact that the spacing between the many original iron columns on view is delineated in one of the lesser known units of measurement: the beer barrel.

After Hodgson, the Bow brewery changed hands several times, finally being bought by Taylor Walker in 1927 and demolished in 1933 to be replaced by council flats. Bow Bridge is now a multi-lane flyover, notable only for a, probably apocryphal, story that a figure from the criminal demi-monde of the 1960s East End is now an integral part of one of its supports.

Martin Adams
SfAM President 2011–2014

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Biofocus: resilience and innovation

As great as it was to say goodbye to 2020, it is safe to say 2021 will not be without challenges. We still do not know when (or if!) life will return to what it was before the pandemic, and it seems goalposts are constantly shifting as we learn more about COVID-19.

However, there is light at the end of the tunnel. Hundreds of thousands are now being vaccinated each day, and I can only express my sincere gratitude to the bioscientists, healthcare workers and volunteers who are working around the clock to make this happen.

The efforts of the biosciences community throughout the pandemic cannot be understated – the community has demonstrated immense determination, resilience, innovation and perseverance across all sectors, not just those working directly on the virus or vaccine.

It is therefore more important than ever to ensure the community is as welcoming and accessible as possible. In November, the All-Party Parliamentary Group (APPG) on Diversity and Inclusion in STEM launched its new inquiry into Equity in the UK STEM workforce.

65% of the STEM workforce are white men, and the STEM workforce still has a lower share of female workers (27% vs. 52%) and disabled people (11% vs. 14%) than other sectors, according to data published by the APPG.

There is still so much untapped talent that can only strengthen and improve the work we do. We responded to the consultation in January, with input from our Diversity and Inclusion working group and from members. We hope our contribution aids in working towards achieving inclusivity.

This work is just the tip of the iceberg of all of the consultation work our science and education policy teams have done. In 2020 we submitted 17 responses covering a broad range of areas including the impacts of the pandemic on education and examinations, open access, T Levels on gov.uk, science funding, food policy and more.

We also launched our Policy Resource Library, which now hosts more than 700 resources, which are free to access, and this number will continue to grow. We hope SfAM members who are interested in bioscience policy will use the Library and find it incredibly useful, as well as allow us to showcase your own contributions where possible.

I'm proud to say the RSB events team has adapted extraordinarily well to moving our events and meetings online.

Mark Downs CSci FRSB
Chief Executive of the Royal Society of Biology

We have hosted two sessions in our new Engaging with Parliament series, allowing members to have discussions with MPs; our Policy Lates series continues to go from strength to strength; and we have hosted annual meetings with hundreds of attendees on behalf of other bioscience organisations. If you are looking for help in running your next online event, we may be able to help.

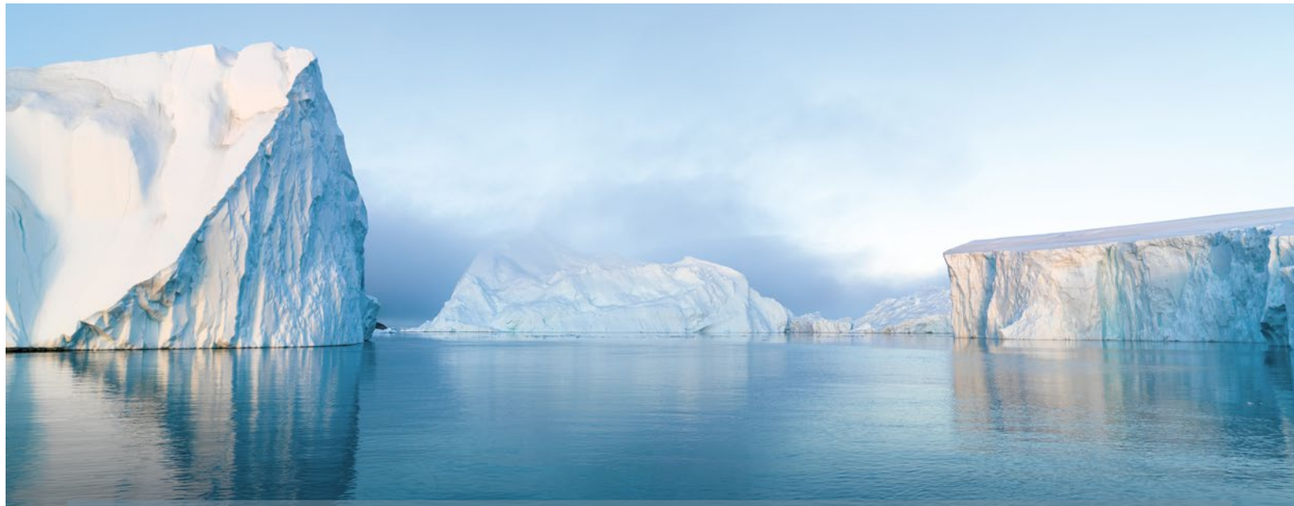
We'll also be hosting online the Plant Health Summit for Future Leaders this month, with plant health researchers expected to join from around the world to discuss the challenges and opportunities within the sector.

We have also successfully moved our Outreach and Engagement work online too. We hosted our first digital science festival in November, Science at Home, in partnership with 23 other science organisations, including SfAM. There are more than 100 free science resources still available online and they are well worth searching for those home schooling and home learning.

We also took Biology Week online: our annual awards ceremony was transformed into a two-day online celebration, and many of our regular events were still able to take place online.

As we move through 2021, despite the circumstances, we will continue to work on behalf of our members and Member Organisations to support the bioscience community in any way we can.

Extraordinary work and talent have been the driving forces of the immense progress already achieved in tackling this pandemic, and we are immensely proud of the role the biosciences have played, and will continue to play, in moving forward.



This work is just the tip of the iceberg of all of the consultation work our science and education policy teams have done. In 2020 we submitted 17 responses covering a broad range of areas including the impacts of the pandemic on education and examinations, open access, T Levels on gov.uk, science funding, food policy and more.

A new dawn for UK science policy

2021 is already proving to be eventful both externally, in the global policy sphere, and internally, in SfAM. Developments regarding Britain's future with the EU, particularly the UK's continued involvement in the Horizon Europe Research Programme, the Science and Technology Committee's responses to its inquiries on COVID-19, and preparations for COP26 and the G7 Summit, are all setting the stage for a year where science is at the forefront of policy.

While we continue to monitor these external developments, we have been working hard to help members combat the winter blues (and lockdowns) by providing you with various ways to connect with fellow members and get involved in SfAM. Our external policy work is based on your priorities and reflects your concerns so be sure to take advantage of the following opportunities to engage with us.

To help you connect with other SfAM members around the world, we have initiated the new Quorum Forum Group under SfAM's Groups. The forum provides users with a platform for sharing experiences and advice or asking questions of fellow members. Although we still cannot meet in person, you can now meet members anywhere in the world via the Quorum Forum.

Lisa Rivera
Policy and Public Affairs Manager

As we are preparing to open vacancies on the Policy Subcommittee (PSC) in the next couple of months, you will hear from SfAM's current Committee members in this issue of the *Microbiologist* (see next article from the PSC's ECS members) and the next issue on their Committee experiences. We hope these experiences shed light on some of the policy work we are doing and even inspire you to apply to join the PSC. It is an excellent opportunity for you to voice your opinion on issues that concern you and help shape the future of microbiology.

Lastly, we have just launched the Andrew Miller Policy Prize competition. This competition has been designed to enable participants to practise their communication and policy skills by producing a two-page policy brief with a chance to win a prize.

More information on the competition can be found online and on the next page.

Andrew Miller **POLICY** COMPETITION

We fully endorse the chief scientist's view that scientific research is not complete until it is communicated effectively

Andrew Miller (1949–2019)

In honour of Andrew Miller, former MP and first Chair of the UK's Science and Technology Committee, SfAM is delighted to launch the Andrew Miller Policy Competition. This competition invites participants to produce a short policy brief on any microbiology topic in the chance to win £300. The winning entrant will be determined by a panel of science policy experts including Dame Sally Davies, UK Special Envoy on Antimicrobial Resistance, and Grant Hill-Cawthorne, Head of the Parliamentary Office of Science and Technology (POST).

All microbiologists from any skill level with an interest in communication and policy are encouraged to participate. Details can be found by visiting SfAM's Policy webpage.

Meet the Policy Subcommittee's ECS members

Whether you are just starting your career or enjoying retirement, SfAM's Policy Committee needs your perspective and skills to ensure our work is robust and reflective of all SfAM's membership. Hear from two early career members sharing their experiences of what it is like to participate in SfAM's Policy Subcommittee (PSC), and the different opportunities it has provided them.

Jacob Hamilton

Member of the SfAM Policy Subcommittee

I applied to SfAM's Policy Subcommittee (PSC) because the relationship between science and politics is something I've been interested in for quite some time. Although I had a fair amount of policy experience, both solo and with SfAM's support, I had applied as much to express an interest in greater involvement with the Society than with any expectation of being awarded a position. Like many other early career scientists, I thought that governance of a learned society was the realm of elderly white professors in the end stages of their careers with a wealth of experience and contacts to draw upon. So, when I was offered a position on the PSC a year into my PhD I was quite surprised. Now, after a year of sitting on the Subcommittee, I see how much of a misconception this was.

The PSC is comprised of a diverse group of scientists, in a variety of career stages and specialisms, from a range of backgrounds. This range is a refreshing change in science and I have really enjoyed hearing everyone's journey into microbiology. This diversity is key to the PSC's effective response to the wide range of policy issues we tackle and our ability to consider the possible implications for various groups of people. It also makes for a welcoming environment where I feel empowered to speak up and voice my opinion. Moreover, I feel like I'm listened to, which is great because otherwise there wouldn't be much point me being there!

As a member of the PSC, I've considered many significant policy challenges. One of the PSC's responsibilities is to contribute to the Society's responses to government consultations. Some consultations can be quite daunting, as they are often outside my area of research. During my time on the Subcommittee, we've worked on waste water treatment, antibiotic use in livestock and the ocean microbiome to name a few – all far beyond my own work on insect/microbe symbiosis.

PSC members also frequently work with the Policy Team to produce briefs for politicians and other stakeholders who themselves are new to the topic in question – so obviously there isn't a neat summary available to us from the start! While I found this especially hard and felt out of my depth when I first joined the PSC, the need to pivot between topics I have little prior knowledge on has helped me to think more dynamically in the lab. This is especially useful when trying to balance three different experiments before going into a seminar.

Despite these challenges, I enjoy working with the PSC, and have volunteered do more with SfAM. Just recently, I was added to SfAM's COVID-19 Task and Finish Group (TFG) on 'Future Preparedness', which is currently looking into vaccine hesitancy – a personal interest of mine and an opportunity to work on my public engagement skills. It's also a great way to meet more people in the policy world and build up my contacts for when I finish my PhD. I'm looking to do more work with the policy team and the TFG – and maybe even getting to meet them in person again soon!

Lucas Walker

Policy Officer for the Early Career Scientists Committee

Working for the Policy Subcommittee (PSC) gave me some valuable insight into how societies such as SfAM work to translate the scientific expertise of their members into policy. As an ECS member, attending PSC meetings was an interesting experience. Having had no prior background in policy, I felt quite out of my depth at first, but feel I have learned a lot from these sessions. Topics of discussion included food safety, marine microbiomes and of course COVID-19. This impressed upon me the breadth of topics that microbiology research can contribute to.

One thing I had not fully appreciated until joining the PSC was SfAM's commitment to diversity and inclusion, having previously only considered science policy through the lens of microbiology research topics (e.g. AMR, microbiomes, biofuels etc.). Meetings always have some time devoted to thinking about how to support the different needs of SfAM members – ECS members in particular.

I also gained some incredibly valuable experience in writing up policy documents on vital issues including antimicrobial resistance and tackling the challenges facing our oceans. This involved identifying members who may have some insight into these topics and working with them to compile the key points we should be outlining to policymakers. This allowed me to delve into areas of microbiology research outside of my own, which I might otherwise not have considered.

As I am now in the final year of my PhD, it is important to know which career pathways are open to me in the future. Working with the PSC has given me a flavour of working in science policy and science communication, both of which are options I will strongly consider going forward!

I had not fully appreciated SfAM's commitment to diversity and inclusion

The latest news, views and microbiological developments

CHROMagar for colourful microbial detection

In 1979 Dr. Alain Rambach introduced his chromogenic technology to the microbiology world. The introduction of this technology triggered a revolution in microbial diagnosis, highly improving and simplifying traditional culture techniques.

Today, CHROMagar supplies the widest range of chromogenic culture media available, covering applications in clinical bacteriology, industrial microbiology, quality control for food and beverage industries, water testing and environmental monitoring... among other fields. These media allow for a quicker and simpler detection of key clinical and food-borne pathogens.

Further information

Visit: **www.bioconnections.net**
Tel: **+44 (0)1782 516010**
Email: **welcome@bioconnections.co.uk**

Save money and give used equipment a new lease of life

At Don Whitley Scientific (DWS) we have expanded our services to include the refurbishment and sale of second-hand DWS laboratory equipment such as anaerobic workstations, spiral platers and sample/media preparators.

Many laboratories are currently experiencing dramatic workload increases due to the pandemic – but unfortunately budgets are often not increasing at the same rate. DWS is providing a unique opportunity to acquire high quality, restored equipment that can still provide several years of reliable service without breaking the bank.

We also periodically rotate our demonstration equipment, giving you the opportunity to purchase newer, higher spec pieces of apparatus with an ex-demo discount.

Our service and apprentice engineers are thoroughly trained in the maintenance of all our legacy equipment, in addition to our current product range. With a choice of maintenance options, from extended warranties to fully comprehensive contracts, DWS enables microbiologists to protect their investments, minimise downtime and keep their labs running as smoothly as possible.

In addition to purchasing used equipment outright, monthly rental plans are also available. These can be tailored to suit your specific needs – whether short or long term. You can also part-exchange an older model and reduce the price of a new piece of capital equipment.

Further information

Visit: **www.dwscientific.com**
Tel: **+44 (0)1274 595728**
Email: **sales@dwscientific.co.uk**

The company Genetic PCR Solutions™ develops an exclusive PCR kit for the new lineage B.1.1.7 emerging in the UK

The test will allow monitoring of the expansion of this new variant of the SARS-CoV-2 that causes COVID-19.

Monday, December 28, 2020. The Spanish company, branded Genetic PCR Solutions™ (GPS™), has developed the qPCR reagent kit **UK-variant B.1.1.7 SARS-CoV-2 dtec-RT-qPCR**, for the specific genetic detection of the new described lineage B.1.1.7 and published in the UK. This SARS-CoV-2 variant expanded rapidly in several British locations and has already jumped to other countries in Europe.

The GPS™ team has analyzed thousands of genomes of this new B.1.1.7 lineage, and other emerging new variants. First of all, they verified that these variants were also detected by the qPCR kit for COVID-19 developed by GPS™ in January 2020, thus once again validating its usefulness as a diagnostic tool in all existing variants. However, there was the need of providing a test that identifies only B.1.1.7 variant to be used as a useful tool for epidemiological surveillance. "Based on unique mutations, specific for this phylogenetic line, we have designed a set of qPCR reagents that only detect this new lineage," says Dr Martínez-Murcia. The new qPCR kit can be performed simultaneously in the same qPCR run with the COVID-19 diagnostic test firstly launched by GPS™, using the same sample and avoiding the complex and expensive method of sequencing to identify SARS-CoV-2 B.1.1.7.

This new kit has already been validated with synthetic RNA genomes and clinical samples following criteria of UNE/EN ISO 17025:2005 and is currently available.

Further information

Visit: **www.geneticpcr.com**
Tel: **+34 96 542 9901**
Email: **info@geneticpcr.com**

Three *Alicyclobacillus* type strains isolated from fruit juices now available from NCIMB

Three type strains of the genus *Alicyclobacillus* have recently been added to the National Collection of Industrial, Food and Marine Bacteria. Strains of this genus are a cause of microbial spoilage in fruit juices. It has been reported that the heat tolerance of *Alicyclobacillus* strains means that they can survive the pasteurisation regimes typically used in fruit juice manufacture, and all three of the newly added strains are acid and heat tolerant, spore forming rods. They were isolated by scientists from Cornell Agritech, and deposited at NCIMB by Cornell University.

NCIMB 15264 *Alicyclobacillus fructus* was isolated from mixed fruit juice concentrate, NCIMB 15265 *Alicyclobacillus sucus* was isolated from apple juice, and NCIMB 15266 *Alicyclobacillus mali* was isolated from pear juice.

NCIMB Ltd. curates the National Collection of Industrial, Food and Marine Bacteria, as well as offering a range of microbiology, biological material storage and analytical services. Our culture collection is comprised of ACDP hazard group 1 and 2 microorganisms isolated from all kinds of environments. It includes not only bacteria, but also plasmids and bacteriophages.

Further information

Visit: **www.ncimb.com**
Tel: **+44 (0)1224 009333**
Email: **enquiries@ncimb.com**

NCPV supporting pandemic research

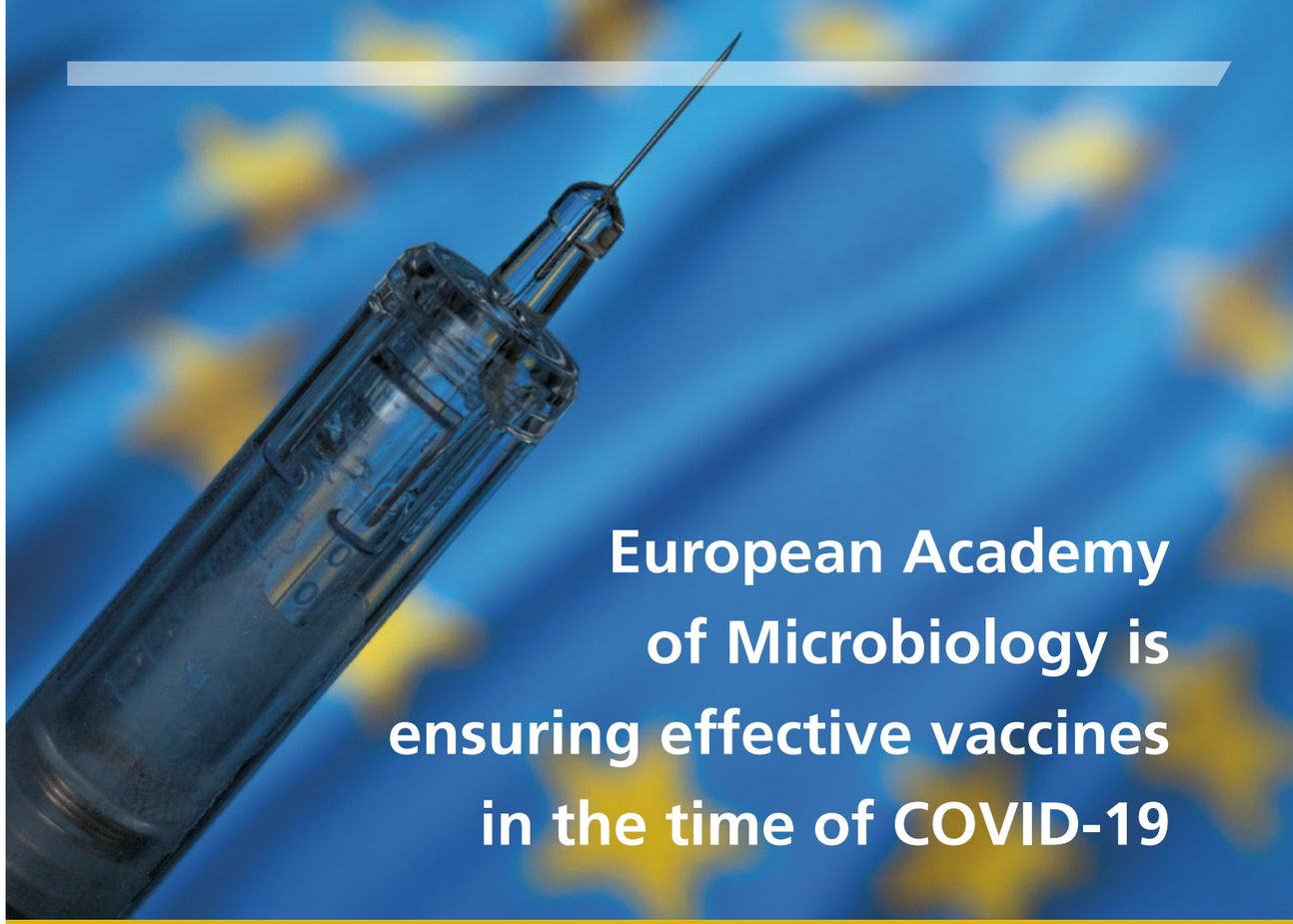
In the last 20 years, three novel coronaviruses have emerged resulting in significant morbidity and mortality. While our recent experiences with SARS-CoV, MERS-CoV and SARS-CoV-2 paint the picture of coronaviruses as an extreme threat to human health, the four other coronaviruses known to infect humans typically result in a milder respiratory illness often referred to as 'the common cold'.

Although significant research surrounding the ongoing pandemic is focussed on SARS-CoV-2, access to isolates of seasonal coronaviruses can assist in multiple areas including understanding tissue tropism, replication dynamics, pathogenesis and assessing specificity of rapid diagnostics and point-of-care tests.

NCPV have released three new accessions to assist the research community: OC43, NL63 and 229E. As these viruses are likely to be used in pandemic-response activities, NCPV are currently offering a 50% discount by using promocode **CORONA50** until the end of March 2021.

Further information

Visit: **www.phe-culturecollections.org.uk/NCPV**
Tel: **+44 (0)1980 612512**
Email: **culturecollections.businessE@phe.gov.uk**
Twitter: **@NCPV**



European Academy of Microbiology is ensuring effective vaccines in the time of COVID-19

Even with a vaccine against COVID-19, there are a number of steps required to ensure it is effective. It will need to be produced in sufficient quantities, extensively distributed globally, and taken up by a high enough proportion of the general population. These are issues for governments as well as scientists to encourage.

Leading experts from the European Academy of Microbiology have produced a paper 'Development of vaccines at the time of COVID-19' discussing current issues surrounding the development and implementation of vaccines.
By explaining the research and development processes and costs, as well as highlighting new technologies that are revolutionising the vaccine landscape, the paper provides advice and highlights key factors both policymakers and researchers need to consider in order to efficiently prepare and roll out vaccination programmes during pandemics.

To read the full paper in microLife journal, visit
https://academic.oup.com/microlife/article/1/1uqaa003/6041022

Federation of European Microbiological Societies

EAM EUROPEAN ACADEMY OF MICROBIOLOGY

Society for Applied Microbiology

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