microbiologist

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The magazine of the
Society for Applied Microbiology

INSIDE

Human microbiome

Faecal transplantation

Citizen science:
Belly button microbiome

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Nancy Mendoza reviews the content of this issue

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The HUMAN MICROBIOME: everybody's talking about it, but what's the appeal?

The communities of microbes that live on and in us, have a profound effect on our health and well-being and, in the case of gut microbes in breast milk, our offspring too (see **http://bit.ly/milkmicrobes**, for example).

In a healthy human, the number of bacterial cells is thought to outnumber human cells by ten to one. It's commonly quoted that around 1kg of bacteria live in the human gut, but, as the 2014 *Journal of Applied Microbiology* lecturer, Professor George Macfarlane told an audience of S*f*AM Members in June, this is a vast overestimation and the real figure is closer to 40–50g (watch the lecture here: **http://bit.ly/JAM_2014**).

A recent paper in *JAMA Pediatrics* (**http://bit.ly/JAMAPed**) highlighted the role of gut microbes in healthy metabolism, describing data that showed a dose-dependent effect of broad spectrum antibiotics in under twos on their risk of being obese by the age of five. So, could obesity, and other health issues, be dealt with by restoring a healthy microbiome? In theory, yes, but as we hear from Jonathan Digby-Bell and David Garner, a faecal microbiota transplant is not a trivial procedure and will likely, for the time being, remain restricted to treating acutely disabling inflammatory bowel diseases. However, they say that new methods of delivery could, in theory, broaden the availability and appeal of faecal transplants in the not-too-distant future. Perhaps we'll all be popping poo pills before long!

In our second feature, Rob Dunn and Holly Menninger from the Your Wild Life Belly Button Biodiversity project describe the world's first microbiology citizen science experiment. Sixty volunteers swabbed the skin inside their own belly button, handing their sample over for identification. Between them, the volunteers had over 2,300 species living in their navels!

Given the success of the Belly Button Biodiversity project, it is perhaps not a shock to realize that the human microbiome has recently become a microbiology topic du jour in the eyes of the general public. Blogger and popularizer of science, Ed Yong, has written and spoken frequently on this topic over the past couple of years; and the UK's Guardian newspaper journalist Ian Sample has said that the frequency of news stories relating to the human microbiome is increasing all the time. This is remarkable, especially given that mechanistic studies of the effects of microbiome on health are really, in the grand scheme of things, only just getting started. Adam Bencard explains that the science of human microbiomes is "*founded on a set of metaphors that are at the core of our cultural concerns at the moment*". This, at least partly, explains its public appeal.

This being the final edition of *Microbiologist* in 2014, we would like to wish you a happy and successful 2015 and look forward to meeting many of you during our regular programme of events.

NEWS IN BRIEF

Romans had good gums

Gum health was better in Roman times than in people today. Scientists studied skulls from AD 200 to AD 400, and found that only 5% had gum disease. **http://bit.ly/Roman_Gums**

Small world – big opportunity

The USA's Small World Initiative offers students research experience whilst crowdsourcing new antibiotics from soil bacteria. The Society for General Microbiology will soon begin running the initiative in the UK with schools and universities. **http://bit.ly/SWI_SGM**

Nancy Mendoza, *Editor*

The human microbiome is increasingly recognized as a key element of health and well-being

FEATURES

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President's column

SfAM works hard to ensure that the voice of applied microbiology is heard on a variety of topics, not least when there are clear opportunities for microbiologists to contribute to solving the grand challenges faced by humanity. With the population set to reach 9 billion by 2050 and a changing climate, we face crises in food and water security – both areas where applied microbiology plays a critical role.

If you saw the Q&A with me in September's edition, you will know that I didn't set out to be a food microbiologist; in fact it was only on my third research post, when I came to Nottingham, that I first started working in the food area. Mine is not an uncommon story – many of my colleagues also started with a broad undergraduate degree and then specialized later on. So when it comes to recruiting undergraduate students, I can understand that many won't want to specialize immediately. However, given the importance of global food security, it is perhaps surprising that food microbiology, in the UK at least, is still a less popular subject when it comes to beginning a research career and I remain the UK's only Chair in Food Microbiology.

SfAM has recently responded to an inquiry into vulnerable skills in research, carried out by two of the UK's public funding bodies – BBSRC and MRC. In this, we highlighted a number of areas of concern, including food microbiology. The real need for more food microbiologists in the UK was also raised by Colin Dennis, whom many of you will know as a doyen of microbiology in the food industry, when he gave the Denver Russell talk on '***Food safety – current and future challenges***' at the 2014 SfAM Winter Meeting. The shortage of skilled food microbiologists and a relative dearth of pre-commercial research comes up repeatedly when I talk to people from the food industry, too.

This situation is perhaps surprising when you consider that, as a discipline, food microbiology includes topics such as disease and bacterial control, which don't fail to attract people to clinical microbiology and other related areas of research. The current approach to food safety looks to control foodborne pathogens from 'farm to fork', so there is an overlap of food microbiology with veterinary microbiology in the control of zoonotic organisms such as *Campylobacter*, *Salmonella* and *E. coli* in the food chain, too. Food microbiology has the same needs for rapid molecular detection methods as clinical microbiology, and has embraced the same non-culture-based molecular techniques for studying microbial populations as environmental microbiology and human microbiome studies.

With the population set to reach 9 billion by 2050 and a changing climate, we face crises in food and water security

Food microbiology is a modern discipline with the potential to ensure access to sufficient safe, nutritious, sustainable food for people all over the world, now and in the future. We have celebrated this at SfAM meetings, over the years, and we will do so, once again, at the 2015 Summer Conference. The topic is microbial fermentation of foods, which happens to be one of my areas of interest. This is a very active area, using approaches such as next generation sequencing, transcriptomics and metabolomics to understand the role microorganisms are playing in developing product characteristics and pathogen control. Of course, we have our regular Winter and Spring Meetings between now and then (further details on pages 42 and 43) and I look forward very much to seeing many of you over the course of 2015.

Christine Dodd
President of the Society

CEO's column

This will be my last column as Chief Executive before I retire at the end of 2014. I am left wondering where the time has gone since I started in the role in April 2005? It has both been an honour and a privilege to be the Society's first Chief Executive for the last nine years. I have thoroughly enjoyed my time at S*f*AM. Yes, the role at times has been challenging but overall it has been a positive experience in my working career.

I would like to thank all the Presidents (Professor Peter Silley, Dr Margaret Patterson, Professor Geoff Hanlon, Professor Martin Adams and finally, Professor Christine Dodd) I have served under for their wise counsel and advice. In addition to the Presidents, thanks are also due to all the other volunteers, i.e., other officers and Committee Members who I have worked with and their hard work, dedication and commitment to the aims of the Society. A special mention must also be made of the three Chief Editors of the journals the Society is involved with. These three individuals (Dr Arthur Gilmour, Professor Jean-Yves Maillard and Dr Ken Timmis) work tirelessly on their respective journals and the Society greatly benefits financially from this activity. I have greatly valued the company and friendship of all those mentioned.

The Society has evolved during the time I have been working as Chief Executive and on a number of measurements I think the signs are very encouraging for my successor:

- **Professionally run office including a more resilient staffing structure.**
- **Many new services introduced since 2005, without any increase in membership subscription rates.**
- **New grants introduced.**
- **Record number of grants awarded in 2013.**
- **Record membership numbers.**
- **Very strong and sound finances.**
- **A very good awareness of the Society by other learned societies and other stakeholders.**
- **Increased delegate attendance at Summer Conferences.**

These are just a few developments which I think bode extremely well for the future of the Society. I do hope that you as Members agree that the Society has developed positively during my tenure.

One other thank you from me is to all the staff (including Sally Hawkes from Kinetix Events) of the Society. I have been fortunate to work with a great bunch of colleagues in the office. Without exception they all have the attitude of "can do" which has made my life a lot easier. We have been extremely effective as a team and this is largely due to the individual commitment shown by all to the group effort, which makes the team work.

The final thank you is to you all as Members of the Society. I have really enjoyed meeting many of you over the years at various Society, and other, events. It has been fascinating meeting and talking with so many of you, and encountering people working in all the various areas that make up the discipline we call 'Applied Microbiology'. Although I am retiring, my intention is to keep in touch with Society activities and I'm looking forward to meeting S*f*AM Members again in the not-too-distant future.

All that remains is for me to wish you all a pleasant holiday period and a prosperous 2015.

Goodbye!

The final thank you is to you all as Members of the Society. I have really enjoyed meeting many of you over the years

Phil Wheat
S*f*AM *Chief Executive Officer (Outgoing)*

SfAM's new Chief Executive

Following a competitive recruitment process, SfAM's Deputy Chief Executive, Dr Lucy Harper has been appointed to succeed Philip Wheat as Chief Executive.

Speaking about the appointment, SfAM President, Professor Christine Dodd said "*I am delighted to continue working with Lucy in her new capacity as Chief Executive. This appointment brings valuable continuity to the leadership team and Members can expect the Society to continue to go from strength to strength.*"

The Society is in an excellent financial position and membership continues to grow, year-on-year.

Lucy said "*The strength of the Society lies in the combination of solid values, an exceptional offering to members, and sound business and financial planning. I am very fortunate to be taking the reins at a time when all three aspects are in good order.*

"*There will certainly be challenges in the coming years, not least the impact of Open Access publishing, but there is every reason to expect that change will be evolutionary rather than revolutionary. The most important thing is that we continue to offer excellent value for money to Members and support the development and application of microbiology in the context of a changing planet.*"

Hello from Lucy

Hello. I am excited to be taking the Society forward as Chief Executive. I do so in the knowledge that I have some big shoes to fill. During his nine years as Chief Executive Phil Wheat was instrumental in creating the progressive and professional Society SfAM is today. Now it's my job to work with the Officers, Trustees, Members and Staff in developing this friendly, open and inclusive Society and its work.

One development already underway, is the series of policy workshops run in collaboration with the Society for General Microbiology (SGM). We are working with Members to find out what are the main issues that we face as microbiologists.

From the first two workshops, the policy issues discussed include open access to data, access to effective disease models and commercial strains of host species, as well as preparing and supporting the next generation of scientists to do excellent interdisciplinary work that includes microbiology. These issues were raised in the context of global challenges such as infectious disease and infection control, food security, antimicrobial resistance and the development of new products. Do you agree that these are the most important challenges/issues? Let us know…

This is a great example of the two societies working together. We are very different organizations, but in areas where our needs and aims are so similar, a collaborative approach means that together we offer a unified voice.

The best way to contact Lucy is to email **lucy@sfam.org.uk** or telephone the office on **+44(0) 1234 326661**.

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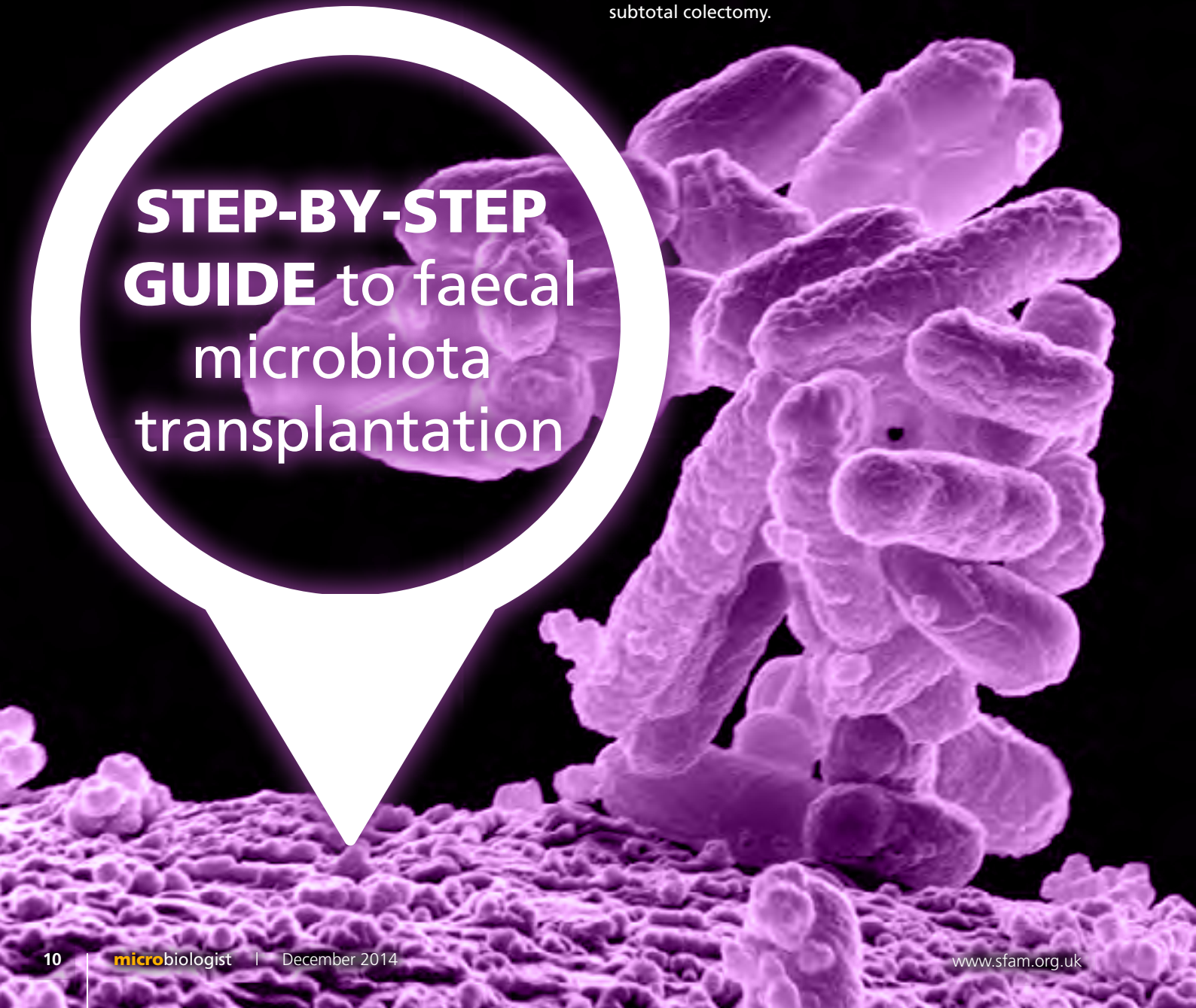
STEP-BY-STEP GUIDE to faecal microbiota transplantation

Evidence for faecal microbiota transplantation (FMT) has been established in *Clostridium difficile* infections (CDI) with a cure rate of 92% (van Nood *et al*., 2013) and has recently been approved by NICE for the treatment of CDI (NICE, 2014).

From a microbiological point of view, FMT represents an almost perfect solution to treating disorders of the flora of the gastrointestinal tract. The gut contains a complex biome of many different bacteria which all form an important part of the flora. Instilling a real mixture of these bacteria in the form of a faecal transplant in order to correct an imbalance makes physiological sense.

FMT is of interest to gastroenterologists as it may provide a genuinely novel approach to treating a number of gastrointestinal diseases and, in particular, inflammatory bowel disease (IBD). IBD patients have been shown to have dysbiotic microbiomes compared with controls, characterized by changes in Firmicutes and Proteobacteria (Morgan *et al*., 2012). A dysbiosis is likely to alter microbiome function and may predispose to, or cause, enteric disease.

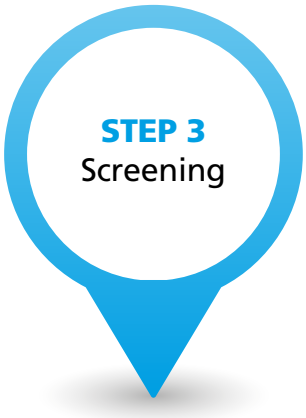
This article follows the journey of a typical but fictional patient; a young man with a four-year history of severe ulcerative pancolitis who had tried and failed all medical therapy. The gastroenterology team were considering a referral to a colorectal surgeon for a subtotal colectomy.



Interestingly, despite the aesthetic concerns that many doctors and the general public have with the procedure, in our practice most patients are happy to consider FMT. In the CDI group they have usually exhausted antibiotic treatments or have had several admissions to hospital so are happy to consider any treatment.

In our experience IBD patients usually request FMT, having read about it in the media, in a bid to avoid surgery or potent immunosuppressants.

A donor less than 50-years-old is preferred as the microbiome becomes less diverse with age (Claesson *et al*., 2011). This may reduce the effectiveness of FMT. As relatives are likely to carry a similar microbiome dysbiosis, a non-related donor is recommended.



There is a risk of transferring an infectious organism when giving a patient a non-sterile sample from another person. This includes not only the obvious gastrointestinal pathogens such as the bacterial, viral and parasitic causes of gastroenteritis but also HIV, hepatitis B, hepatitis C and CMV. A rigorous screening process of the donor faeces is paramount to reduce transplant morbidity.

Safety concerns were recently highlighted by a case report of CMV colitis probably contracted by home FMT from an unscreened donor (Hohmann *et al*., 2014).

No screening consensus exists yet but a pre-procedure screening protocol is suggested in Table 1. Screening of the recipient is less critical than that of the donor but background infection testing of the recipient is advised in case serological conversion or acute infection post-FMT occurs.

	DONOR	RECIPIENT
Serology	HIV	HIV
	Hepatitis A, B & C	Hepatitis A, B & C
	Syphilis	Syphilis
	CMV & EBV (IgG & IgM)	CMV & EBV
	HTLV 1 & 2 (if time allows)	
Faecal tests	Routine culture	
	Ova, cysts & parasites	
	Rotavirus	
	Norovirus	
	Adenovirus	
	Clostridium difficile toxin	
	Helicobacter pylori antigen (if NJT used)	

FMT is of interest to gastroenterologists as it may provide a genuinely novel approach to treating a number of gastrointestinal diseases

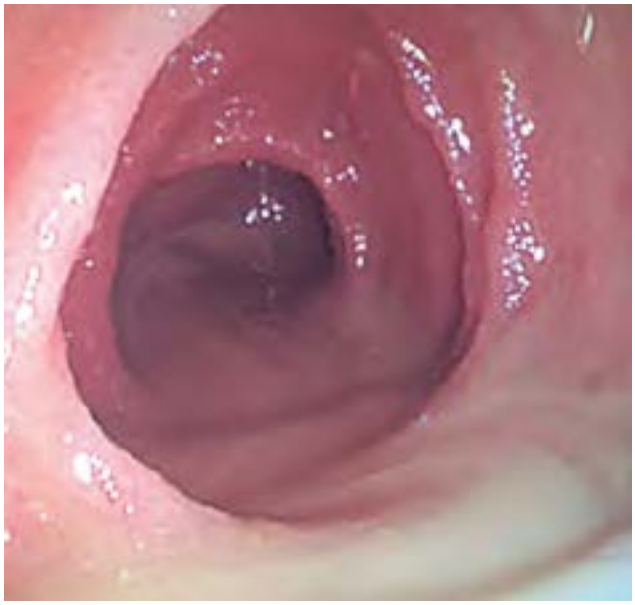
STEP 4
Choice of administration route

Routes of administration are via colonoscopy, nasojejunal tube (NJT) or rectal enema. Choice of route will depend on the site of disease, patient co-morbidities and patient preference.

Colonoscopy delivers the transplant directly into the right colon but carries a risk of perforation. Therefore, the risk of the procedure may outweigh the benefits, particularly in patients with severe CDI or severe colitis. NJT delivers the transplant into the right colon but has the theoretical potential for causing small bowel bacterial overgrowth in the future and suffers from greater patient aesthetic concerns than the other routes. Finally, an enema is safe and more aesthetically acceptable but is unlikely to reach the right colon and therefore may not be as effective.

STEP 5
Patient preparation

Bowel preparation should be undertaken for all patients undergoing FMT regardless of the administration route. Excellent bowel preparation is paramount to expel as much of the patient's own microbiota as possible. Theoretically, this will increase the chances of the transplanted microbiota repopulating the patient.



STEP 6
Donor preparation

The donor is provided with a wide diameter disposable mixing jar with a screw-on lid in which to deposit and transport their sample to the hospital. Ideally the donation should be between 100g and 200g. Many donors require a gentle stimulant laxative (e.g., Senna) the night before donation to enable delivery to the microbiology laboratory before 9am.

STEP 7
Transplant preparation

The laboratory preparation of the faecal sample is relatively straightforward. The sample should be handled in a clean area of the laboratory in order to prevent the sample becoming contaminated with gastrointestinal pathogens from the laboratory environment.

The sample can then be emulsified in 250ml of sterile normal saline, passed through sterile gauze in order to remove particulate matter, and returned to the clinical area in the appropriate device for administering to the patient; either syringes for colonoscopy, enteral feeding containers for NJT or enemas.

STEP 8
Transplant delivery

Before the delivery of the transplant, regardless of the route chosen, the patient should be prescribed 4mg loperamide (an anti-diarrhoeal agent) and encouraged not to defaecate for as long as possible.

Colonoscopy – a standard colonoscopy is performed to the terminal ileum with minimal insufflation of air and suction of any debris on insertion. The transplant is flushed down the biopsy channel into the lumen in the following proportions: ¼ into the terminal ileum, ½ into the caecum and ¼ into the transverse colon.

NJT – the patient should have clear fluids only in the preceding hours. The transplant is connected to the NJT and given at a rate of 50ml/hr until complete.

Enema – once inserted, the patient is encouraged to roll gently on the bed to encourage the transplant to reach the right colon.

Few post-transplant complications have been reported but abdominal pain, loose stool and fever are the most common which usually require conservative treatment. In CDI, clinical improvement is expected within 24–48 hours but in non-infectious aetiology the time to improvement is likely to be days to weeks.

Conclusions

FMT is in its infancy and the spectrum of disease which it will treat is not yet defined. It has the potential to be effective and cheap but carries a significant risk of transmission of infection and the cost of screening is not insignificant. Several centres are creating 'stool banks' containing only highly vetted and screened stools from known donors which will significantly reduce the risks and improve reliability of FMT.

The role for FMT in CDI is clear but the evidence for FMT in other disease processes is currently lacking. However, there are numerous ongoing trials of which the results are eagerly expected. As our understanding of the role of bacteria in immunology and development increases, potential targets for bacteriotherapy may arise.

FMT in its current state involves the complete replacement of the host microbiota. Further research into the microbiota in health and disease may define specific deficiencies of the host and instead of replacing the whole microbiota, it may be possible to replace only targeted bacteria.

Methods of delivery are rapidly evolving and it is entirely feasible for pH-controlled colonic release capsules containing faeces or specific bacterial cocktails to be available in the next few years.

As our understanding of the role of bacteria in immunology and development increases, potential targets for bacteriotherapy may arise

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Jonathan Digby-Bell left
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David Garner right
Microbiology Department, Frimley Park Hospital, Surrey

WORLD'S FIRST citizen science microbe project

Working in the 1600s in the little city of Delft, Holland, Antoni van Leeuwenhoek discovered the microscopic world. There had been hints, of course, glimpses through hand lenses at the possibility that more lurked in the miniscule than had so far been noted, and yet they were just that, glimpses. Leeuwenhoek did more than glimpse. He dove in. An amateur scientist, in the grandest sense of the word (where amateur comes from the root 'to love'), Leeuwenhoek discovered bacteria, protists and among them, hundreds of previously unnoted forms.

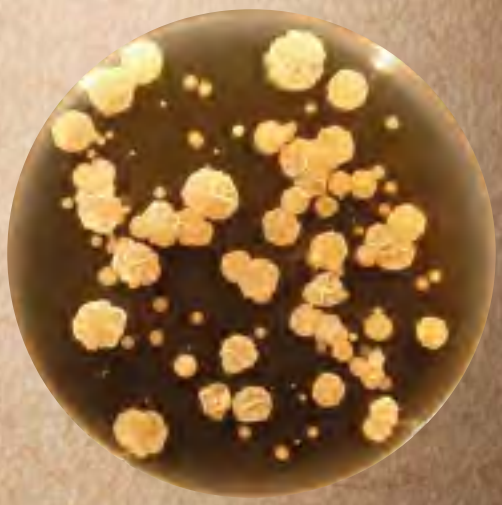
When considering the microscopic, Leeuwenhoek never detected any malice in the forms he encountered. This would lead, in later generations, to the criticism of this curious man, criticism for his failure to detect pathogens and, in doing so, to develop the germ theory of disease (which would, in turn, save millions). But much time has passed since those criticisms and as we now examine what has been discovered over the last century about the beneficial role so many microbes play, one would have to, on average, agree with Leeuwenhoek. While a tiny majority of microbial taxa both kill us and outright threaten the pillars of civil society, most are either benign or beneficial.

The trouble is that for the most part the public's perception of this tiny life on which we all depend for existence in so many ways – immune defence, metabolism, decomposition, the production of antibiotics and sourdough bread to name a few – is far more like the perception of those who criticized Leeuwenhoek than it is like Leeuwenhoek. Many, perhaps most, believe that the words (and ideas) of pathogens and microbes are synonymous and that we'd all be better off if we could just scrub, spray and otherwise cleanse this realm away. There is a disconnect,

When considering the microscopic, Leeuwenhoek never detected any malice in the forms he encountered

*In 2011 we initiated what we think was the first citizen science project on microbes, the **Belly Button Biodiversity project** (**navels.yourwildlife.org**).*

In this project, we asked the public to swab the microbes on and in their belly buttons. We then cultured these microbes (so that people might see pictures of what lives on them) and also sequenced them to parse out who's who on a given person.



in other words, between our daily dependence on microbial life and our perception of it. It is this disconnect that feeds into the overuse of antibiotics, the use of antimicrobial creams and wipes and, as a consequence, a growing number of deaths due to infections with resistant bacterial strains.

There are many approaches to engaging the public in a reconsideration of this small life. The approach we take at Your Wild Life (**yourwildlife.org**) has been to engage the public, those loving amateurs, in actually doing science. Our thesis is that by engaging people in studying the microbes in their own lives we can simultaneously undertake new science, create an opportunity for education about microbial life, and, we hope, inspire people to act differently with regard to their use of antibiotics and antimicrobials, to act differently toward the smaller majority of life.

So what have we done? In 2011 we initiated what we think was the first citizen science project on microbes, the Belly Button Biodiversity project (**navels.yourwildlife.org**). In this project, we asked the public to swab the microbes on and in their belly buttons. We then cultured these microbes (so that people might see pictures of what lives on them) and also sequenced them to parse out who's who on a given person. The very first project focused on belly button microbes both because the belly button is a harmless entre into discussing the body more generally (we assumed, though didn't test the hypothesis, that rectal swabbing would be an unpopular museum activity!), the belly button is less exposed to both scrubbing and chance arrivals of new microbes than, say, the hand, and because the microbes on the belly button are key to infant survival in as much as they influence whether or not the umbilical stub, post-birth, becomes infected. This project was a success; it allowed us a glimpse into the variation among individuals of their skin microbes, provided a fantastic chance for discussing the biology of skin microbes and led to several other citizen science microbiology projects. The American Gut project, for instance, was directly inspired by the Belly Button Biodiversity Project.

The Belly Button Biodiversity project continues. We are now trying to link skin microbial composition to the composition of volatile compounds on the skin to, in turn, the attractiveness of individual people to mosquitoes. Can we, in other words, predict whether mosquitoes bite you on the basis of a swab of your belly button (and, more importantly, might we be able to alter this fate). But our bigger initiative has been to go back to that habitat that Leeuwenhoek first considered, the home and all of its interstices.

We have now worked with 1,430 people to sample the microbes in their houses (1,430 being the number of participants you get when you seek 1,000 participants and after getting 1,000 find yourself with another 430 super excited people whose eagerness makes you want to include them and find extra funding for sequencing them later). This set of 1,430 builds upon a pilot project with 40 people in North Carolina (**homes.yourwildlife.org; DOI: 10.1371/journal.pone.0064133**). Each of these 1,430 people has swabbed the dust in each of four places in their home. We have then, to ensure the reliability of these samples, intensively sampled a subset of these homes ourselves (every month for a year and using many different sampling approaches).

By engaging people in studying the microbes in their own lives we can simultaneously undertake new science, create an opportunity for education about microbial life, and, we hope, inspire people to act differently with regard to their use of antibiotics and antimicrobials, to act differently toward the smaller majority of life

Image © Noah Fierer

We hope that with our modest encouragement that the citizens who work with us go on not just to have a new appreciation for the life around them and for the discoveries of which they have been a part, but also for their own ability to make discoveries

Our collaborator on this project, Noah Fierer and his team, have sequenced the samples using one approach to parse the bacteria and archaea, another for fungi, another still, though this is work in progress, for the microscopic bits of animal DNA floating around in homes. In doing so, we have found an extraordinary diversity of forms. More than 100,000 taxa whose occurrence, we are finding, tells us something about the biology in and around houses, a great deal really, but first and foremost makes clear that while in every house there are probably some pathogens, those pathogens are a drop in an enormous bucket of interesting, unstudied life, most are either benign or beneficial.

With all our data and projects, we invite the public to participate in every way that we can envision. But we also invite scientists to come together, to work with us to see things we have missed (to focus on particular species of interest, for example. Anyone interested in the insect-associated species of *Chlamydia*? Those, it turns out, are all throughout houses), but also to imagine new projects. We work with many thousands of interested citizens from around the world, citizens who are hungry to know more about their own lives, citizens who are delighted to engage in the new projects you might imagine on gutters, pepper shakers and much else, the thousands of curious citizens examining their own lives.

I think that our work in citizen microbiology was the first project of its kind. Certainly it was the first in this recent generation. But, of course, the real first citizen microbiology project was that of Leeuwenhoek. He was a citizen who, with some modest encouragement from some scholars in the UK, discovered an entire world. In the same way, we hope that with our modest encouragement that the citizens who work with us go on not just to have a new appreciation for the life around them and for the discoveries of which they have been a part, but also for their own ability to make discoveries. It is for this reason we upload our data as soon as we can (after sequencing, processing, web design and the other necessary and sometimes time-consuming steps) that someone out there might look through the pepper grains of our data to find things we have missed, things that are all around us and yet still unstudied are both wondrous and alive.

Rob Dunn left **Holly Menninger** right

Image of Holly © Russ Creech

Our ecosystem is going viral – some thoughts on **MICROBIOME** METAPHORS

In 1992, the Nobel prizewinning geneticist Walter Gilbert wrote about the promises of the Human Genome Project (HGP), and said that one day "… three billion bases of DNA sequence can be put on a single compact disc and one will be able to pull a CD out of one's pocket and say, 'Here is a human being; it's me!'" His essay was entitled "A Vision of the Grail," and it was published in a book called "*The Code of Codes.*" Looking back more than a decade after the publication of the full draft of the human genome, it is clear that among its supporters the HGP inspired a great deal of rhetorical exuberance, if not excess. The project became a quest for the "the book of life" and the promises of swift clinical translations were many.

In her history of the genetic code, Lily Kay has described how the fundamental processes of life began to be represented as processes of information storage and transfer. Heredity was understood as a process of transmission of information and understanding that was transmitted through a number of informational metaphors (Kay, 2000). These hyperbolic conceptions in retrospect came to "overshadow what was essentially an extensive road-building project for genetic exploration" (Cook-Degan, 1995).

Perhaps burned by the public fallout after the rhetorical excesses of the HGP, The Human Microbiome Project was launched in 2007 with much less fanfare. However, microbiome studies have been gathering a massive momentum in the past 5–7 years and are now on the verge of going viral in the public imagination – a headline in the New York Times recently boldly stated that 'We Are Our Bacteria' and similar examples are springing up every day. As a recent comment in *Nature* noted, this enthusiasm seems to be overheating and microbiomics "risks being drowned in a tsunami of its own hype" (Hanage, 2014). On his widely read blog *The Tree of Life* (www.phylogenomics.wordpress.com), Professor at UC Davis, Jonathan Eisen, is busy handing out a recurrent 'Overselling The Microbiome Award'.

These descriptive metaphors – our body as an ecosystem, ourselves as communities, our health and illness as resulting from a complex, multi-species super-organism

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I would suggest that part of this overheating has to do with the cultural strength of the metaphors used to describe microbiome research. As Evelyn Keller writes, "not all metaphors are equally useful or, for that matter, equally captivating. The effectiveness of a metaphor, like that of a speech act, depends on shared social conventions and, perhaps especially, on the authority conventionally granted to those who use it. It also depends on other family resemblances already in place" (Keller, 1995). And it so happens, that microbiome research was rhetorically (and conceptually) founded on a set of metaphors that are at the core of our cultural concerns at the moment: ecologies, communities, super-organisms and networks.

These descriptive metaphors – our body as an ecosystem, ourselves as communities, our health and illness as resulting from a complex, multi-species super-organism – speak to contemporary cultural concerns about ecological disaster, global warming, antibiotic overuse, the abundance of processed food and the food industry, the increase in autoimmune diseases and many more similar concerns that all point to us as inhabiting an opaque system out of balance. Microbiome research, due to its practical and metaphorical emphasis on ecosystems and communities, is seductive to the public because it rhetorically enters a complex web of contemporary cultural concerns; e.g., we live in a culture in which things go viral every day and where we all belong to digital communities and networks. Publics are likely to be captivated by microbiome research, in part, because it offers explanations that match its current conceptual categories – it scratches a deep cultural itch, so to speak.

Microbiome researchers and microbiologists would therefore do well to attend to the cultural circumstances in which their statements have effects. Metaphors are not merely a means of popularization or a specific kind of modelling but rather are representations that can unfold an operational force of their own. This does not mean abandoning metaphors – they are unavoidable, and as useful and generative as they are seductive – but rather to develop sensitivity to the wider cultural contexts in which they function. Scientists, after all, like everyone else are language-speaking actors; "by their words, their very landscapes of possibility are shaped" (Keller, 2000). But it is necessary to realize the extent to which the metaphors that characterize microbiome research speak profoundly to this cultural moment, much as the notion of life as information did in the last half of the 20th century.

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Adam Bencard
Medicinsk Museion, Københavns Universitet

HISTORICAL PERSPECTIVES

Figure 1

Palaeopathology of teeth

The most surprising aspect of ancient teeth and jaws to the modern viewer is probably the severe wear of the dentition by middle age (Figure 1). This was caused mainly by the sheer amount of grit contained in the staples of their diet (modern methods of milling and refining cereals did not appear in Europe until the 18th century). In addition, as food was often in short supply, most people completely demolished whatever food was available: bones, cartilage, skin, stalks, husks and all. They would consider us moderns to be excessively fussy eaters. Teeth react with the environment both physically and chemically, and the abrasive tracks evident in enamel enable us to analyse in detail the texture, abrasiveness and constituents of the diet. Lesions produced by diseases of teeth and their supporting structures can tell us much about diet, which is often strongly related to economic and social status. The state of development and degree of wear observed can provide a good estimation of an individual's age. Teeth also provide evidence of cultural behaviour patterns, interrelationships between diet and disease, and display the characteristic wear patterns produced by different types of diet or by use of the teeth as a tool or vice. Wear, if more rapid or severe than natural mechanisms could cope with, as it often was in the past, brought about exposure and death of the dental pulp, leading to infection, pain and abscesses.

During childhood, deciduous teeth erupt, exfoliate and are replaced, and permanent molars erupt in a sequence which means that we can usually age children within +/- 18 months (Figure 2). Every individual's enamel retains a microscopic and permanent record of the first eight or nine years of their life when their crowns were being formed and these incremental layers

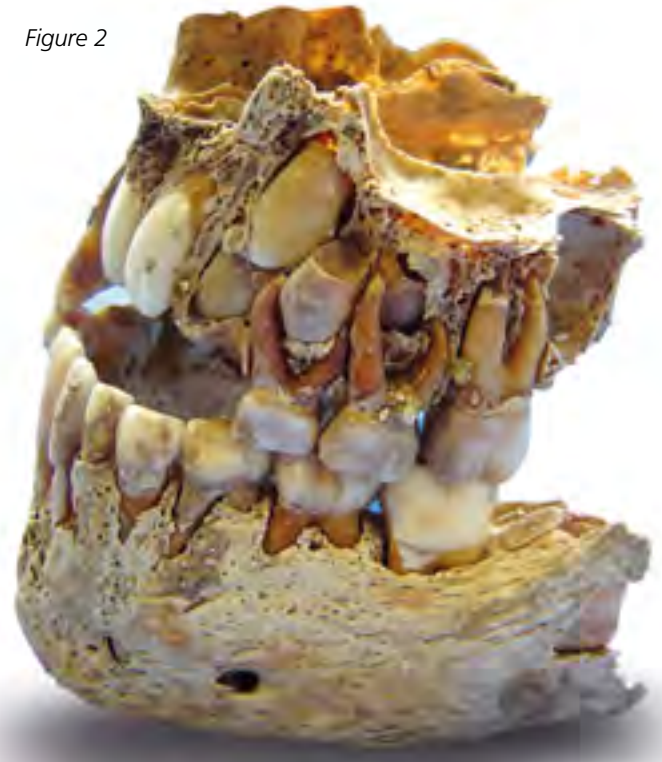
Teeth react with the environment both physically and chemically, and the abrasive tracks evident in enamel enable us to analyse in detail the texture, abrasiveness and constituents of the diet

detailed patterns of nutrition and disease (Figure 3). By comparing the stable isotope levels conserved within the teeth of the dead adult to those in the bones, migration can be clearly demonstrated. Analysis of enamel can tell us at what age the child was weaned and how sudden or gradual that process was. Teething was blamed for the death of many children in the 17th century's *London Bills of Mortality*. It is more likely that with the sudden loss of nutrients and maternal immunity provided by human milk, it was children's exposure to pathogens at that age which was the true culprit.

Oral bacteria adhere to the surfaces of teeth by depositing a mucopolysaccharide coating on the enamel and this substrate is then colonized by other oral commensals. When formed, this soft deposit can be removed by thorough and skilled cleaning once a day, but where left undisturbed it gradually calcifies, forming thick porous concretions (calculus or tartar) on the outer surfaces of the crowns. Before the advent of modern oral hygiene aids, some calculus was universal, because there was no really effective method for its removal.

Figure 3

Figure 2



Dental enamel is one of the hardest materials known, enabling the teeth to survive a lifetime of chewing, but enamel has an Achilles' heel. As soon as the oral environment falls below pH 5 the enamel erodes. Plaque organisms held in close long-term contact with enamel metabolize food residues, producing acids, lowering the pH and producing a cavity (dental caries). This is less common in the archaeological record than one would expect and was largely a disease of the prosperous. However, dental caries became almost universal in Europe in the late 19th century when cheap sugar became easily available.

Periodontal disease is the result of the accumulation of bacterial plaque at the gum margins leading to destruction of the periodontal tissues that anchor teeth to the jawbone. It results in the formation of a pathologically deepened crevice around the root resulting in the teeth loosening, drifting and exfoliating. Periodontal disease is usually painless but it is progressive and irreversible. Fortunately, most populations tend to have fewer than 10% of individuals who exhibit advanced levels of destructive periodontitis.

The voids seen in jaws from archaeological collections are often dramatic (Figure 4) and excite great interest, adding to the mystique of the past. These have, until recently, been described routinely as "abscesses" with all that this implies about pain, infection and general health. Extensive modern histological studies indicate, however, that such voids are relatively common, are usually completely painless granulomas and less than a third of them may be actually infected. It is important to realize that a dental pulp in a mature tooth has virtually no ability to repair itself when damaged, whatever the cause. Its blood supply arrives through minute channels in the root, and any inflammation in the virtually sealed pulp chamber builds up the internal pressure, blocks the blood supply and leads to death of the pulp. The necrotic pulp then undergoes autolysis (self digestion), which will be sterile, if oral organisms cannot gain access. The soft tissues surrounding the root apex of the tooth respond to the concomitant release of breakdown products with an inflammatory response and this sphere of cells surrounding the root apex, (a periapical granuloma), creates a space in the surrounding bone. It is this space that is seen in osteological specimens or radiographs. If there is such a cavity related to a tooth apex, it reveals for certain that the dental pulp must have been dead for some time (Figure 4).

A granuloma is maintained by the presence of indigestible or constantly replenished foreign material and/or a cell-mediated immune reaction against the injurious agent. In the case of dental granulomas, breakdown products continue to leak from the root apex, as polymorphs are unable to access the necrotic pulp chamber and remove its contents. The central areas of such granulomas often undergo necrosis as they become remote from their blood supply. This leads to the formation of cystic spaces within them which undergo slow enlargement, as osmotic pressure leads to fluid build-up in the interior and they become lined by a membrane developed from epithelial cells.

Such a necrotic pulp and granuloma/cyst is highly likely to become infected at some time through contamination from the mouth, by bloodborne infection or by a reduction in host immune response due to illness, stress or malnutrition. An acute and painful abscess rapidly invades trabecular spaces and vascular channels, but does not form a bone cavity because there is insufficient time for bone resorption. The pus tracks through bone, taking the path of least resistance, until it reaches an outer surface where it discharges. These convoluted, multiple and narrow pathways are difficult to identify *in vivo*, let alone in dry bone. The presence of a visible sinus in the jaw is evidence that there had been a painful abscess which was now draining and had become chronic and relatively pain-free. Before the advent of antibiotics, individuals frequently died from dental causes as

Figure 5

The voids seen in jaws from archaeological collections are often dramatic and excite great interest, adding to the mystique of the past

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infections could easily spread. The *London Bills of Mortality* in the early 1600s listed the causes of death and "teeth" were continually listed as the fifth or sixth commonest cause of death in adults.

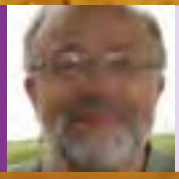
The most common lesions are best described histologically as granulomas, but cyst development occurs in nearly a half of cases. If such voids do not clearly involve the apex of the tooth it is more likely to be a local manifestation of a systemic disease, e.g., multiple myeloma or metastatic carcinoma, and there will be similar lesions elsewhere in the skeleton.

A thin and sharp margin where the void meets the cortical surface of the alveolus indicates the presence of a non-infected granuloma or cyst. If the margin is rolled or thickened and the bone appears to have been frequently remodelled, often with a halo of new bone around the orifice, then this represents a chronic abscess, which would have been seeping pus for a considerable period.

Figure 4

Without any effective dental treatment available other than extractions, past individuals inevitably developed apical lesions as they aged and their dental pulps were killed by attrition, trauma or caries (Figure 5). Individuals with periapical voids were not necessarily ill, and the common presence of several such lesions may simply indicate that their immune systems were healthy enough to subdue and contain these over a long period of time.

Teeth and bones, being highly mineralized body structures, are uniquely well-preserved remains of people from the past, giving evidence of their owners' life-history, diet, the diseases they suffered and the societies to which they belonged.



Alan Ogden
University of Bradford

BIOLOGY: Changing the World

Biology Week 2014 was an excellent celebration of all things life science around the UK, offering people the opportunity to get involved in science and learn more about the world around them. Events ranged from a debate on the eradication of malaria to regional "Big Biology Days" with hands-on events for members of the public. There were also career fairs and a wide variety of talks including "the future of drugs" and healthcare. Both the macro and micro level of bioscience were covered through ecology-based field trips to the practical use of microscopy. We also celebrated achievements in science communication, anatomical drawing, life science photography and science writing.

Amongst all this variety, however, we were particularly pleased to make available for the first time the Society of Biology's '**Biology: Changing the World**' app and website (**biologyheritage.societyofbiology.org**). These have been produced as part of our biology heritage project, a major communications project for us this year.

Biology: Changing the World is a 15-month project, funded by the Heritage Lottery Fund, and in partnership with BBSRC, that is inspiring and celebrating great biologists around the UK. From blue plaques to a website, the project seeks to commemorate some of our best known biologists alongside the unsung heroes of biology and inspire those of the future. Our mobile app for Apple and Android devices allows users to find out more about the history of biology including what has happened locally to where the apps are used. Combined with a quiz and a wealth of background information we hope it will prove a great way to engage a different and wider community, with the value and inherent interest of the life sciences.

This is the Society of Biology's first project to focus on the heritage of biology. Although exploring the historical side of the life sciences is a relatively different approach, it fits with a lot of the messages that the Society, and our sister societies are currently promoting.

BIOFocus

Both the **macro and micro level of bioscience were covered** through ecology-based field trips to the practical use of microscopy

Our current work with diversity, returners to work and improving the status of teaching in higher education fit well with sharing the stories of some of the less well-known faces of biology, who have changed the world in which we live.

One clear example of this is Kathleen Mary Drew Baker, a figure not particularly well known in the UK, whose phycological work had such great benefit in stabilizing the harvest of the edible seaweed Nori, that she has a national day of celebration in her honour, and is known as the 'Mother of the Sea' throughout Japan.

As well as raising the profile of some of our sectors lesser known heroes, we've also used the project as an opportunity to highlight the UK as a place of great science. We are installing commemorative plaques around the UK to mark the achievements of some of our greatest biologists (and for Dolly their "progeny"!) and can announce that some of the first plaques to be installed as part of the project will be:

- **Dolly the sheep**
- **Fred Sanger**
- **Honor Fell**
- **Marjory Stephenson**
- **Dorothy Hodgkin**
- **Alan Hodgkin & Andrew Huxley**
- **Anthony Carlisle**
- **JBS Haldane**
- **Richard Owen**

Our project aims to involve the entire bioscience community, and we've engaged our sister societies through stakeholder meetings and public nominations. It has been tremendously encouraging to receive so many positive responses. This will continue as the project develops and grows, and we welcome any suggestions for notable scientists from SfAM Members to **bcw@societyofbiology.org**.

We have also tried hard to make this a UK-wide activity interviewing over 50 biologists about their own career and which biologists inspired them the most across the country with formal launch events in Manchester and London.

We are already starting to plan for Biology Week (October) 2015 and would be delighted to hear new ideas.

Mark Downs FSB
Chief Executive, Society of Biology

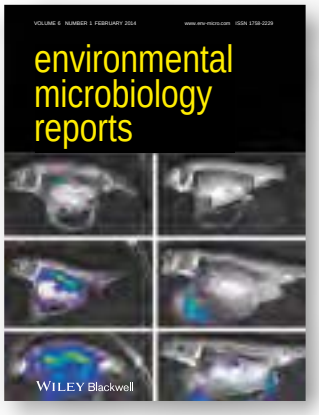
Journal**WATCH**

Highlighted Articles from the *Sf*AM journals

Environmental Microbiology Reports

www.env-micro-reports.com

Evaluation of rhizobacterial indicators of tobacco black root rot suppressiveness in farmers' fields



M. Kyselková, J. Almario, J. Kopecký, M. Ságová-Marečková, J. Haurat, D. Muller, G. L. Grundmann and Y. Moënne-Loccoz.

Very few soil quality indicators include disease-suppressiveness criteria. We assessed whether 64 16S rRNA microarray probes whose signals correlated with tobacco black root rot suppressiveness in greenhouse analysis could also discriminate suppressive from conducive soils under field conditions. Rhizobacterial communities of tobacco and wheat sampled over two years from four farmers' fields of contrasted suppressiveness status were compared. The 64 previously identified indicator probes correctly classified 72% of 29 field samples, with nine probes for *Azospirillum*, *Gluconacetobacter*, *Sphingomonadaceae*, *Planctomycetes*, *Mycoplasma*, *Lactobacillus crispatus* and *Thermodesulforhabdus* providing the best prediction. The whole probe set (1,033 probes) revealed strong effects of plant, field location and year on rhizobacterial community composition, and a smaller (7% variance) but significant effect of soil suppressiveness status. Seventeen additional probes correlating with suppressiveness status in the field (noticeably for *Agrobacterium*, *Methylobacterium*, *Ochrobactrum*) were selected, and combined with the nine others, they improved correct sample classification from 72% to 79% (100% tobacco and 63% wheat samples). *Pseudomonas* probes were not informative in the field, even those targeting biocontrol pseudomonads producing 2,4-diacetylphloroglucinol, nor was quantitative PCR for the 2,4-diacetylphloroglucinol-synthesis gene *phlD*. This study shows that a subset of 16S rRNA probes targeting diverse rhizobacteria can be useful as suppressiveness indicators under field conditions.

Symbiont-driven sulfur crystal formation in a thiotrophic symbiosis from deep-sea hydrocarbon seeps

I. Eichinger, S. Schmitz-Esser, M. Schmid, C. R. Fisher and M. Bright.

The siboglinid tubeworm *Sclerolinum contortum* symbiosis inhabits sulfidic sediments at deep-sea hydrocarbon seeps in the Gulf of Mexico. A single symbiont phylotype in the symbiont-housing organ is inferred from phylogenetic analyses of the 16S ribosomal ribonucleic acid (16S rRNA) gene and fluorescent *in situ* hybridization. The phylotype we studied here, and a previous study from an arctic hydrocarbon seep population, reveal identical 16S rRNA symbiont gene sequences. While sulfide is apparently the energy source for the symbionts (and ultimately the gutless host), both partners also have to cope with its toxicity. This study demonstrates abundant large sulfur crystals restricted to the trophosome area. Based on Raman microspectroscopy and energy dispersive X-ray analysis, these crystals have the same S8 sulfur configuration as the recently described small sulfur vesicles formed in the symbionts. The crystals reside adjacent to the symbionts in the trophosome. This suggests that their formation is either extra- or intracellular in symbionts. We propose that formation of these crystals provides both energy-storage compounds for the symbionts and serves the symbiosis by removing excess toxic sulfide from host tissues. This symbiont-mediated sulfide detoxification may have been crucial for the establishment of thiotrophic symbiosis and continues to remain an important function of the symbionts.

Environmental Microbiology

www.env-micro.com

Loss of microbial diversity in soils is coincident with reductions in some specialized functions

B. K. Singh *et al*.

Loss of microbial diversity is considered a major threat because of its importance for ecosystem functions, but there is a lack of conclusive evidence that diversity itself is reduced under anthropogenic stress, and about the consequences of diversity loss. Heavy metals are one of the largest, widespread pollutant types globally, and these represent a significant environmental stressor for terrestrial microbial communities. Using combined metagenomics and functional assays, we show that the compositional and functional response of microbial communities to long-term heavy metal stress results in a significant loss of diversity. Our results indicate that even at a moderate loss of diversity, some key specialized functions (carried out by specific groups) may be compromised, and based on our studies, we propose a conceptual framework to explicitly consider diversity of functions and microbial functional groups to test the relationship between biodiversity and soil functions.

Life with compass: diversity and biogeography of magnetotactic bacteria

W. Lin, D. A. Bazylinski, T. Xiao, L.-F. Wu and Y. Pan.

Magnetotactic bacteria (MTB) are unique in their ability to synthesize intracellular nano-sized minerals of magnetite and/or greigite magnetosomes for magnetic orientation. Thus, they provide an excellent model system to investigate mechanisms of biomineralization. MTB play important roles in bulk sedimentary magnetism and have numerous versatile applications in paleoenvironmental reconstructions, and biotechnological and biomedical fields. Significant progress has been made in recent years in describing the composition of MTB communities and distribution through innovative cultivation-dependent and -independent techniques. In this review, the most recent contributions to the field of diversity and biogeography of MTB are summarized and reviewed. Emphasis is on the novel insights into various factors/processes potentially affecting MTB community distribution. An understanding of the present-day biogeography of MTB, and the ruling parameters of their spatial distribution, will eventually help us predict MTB community shifts with environmental changes and assess their roles in global iron cycling.

Letters in Applied Microbiology

www.lettersappliedmicro.com

Towards light-mediated sensing of bacterial comfort

G. Zafrilla *et al*.

Bacterial comfort is central to biotechnological applications. Here, we report the characterization of different sensoring systems, the first step within a broader synthetic biology-inspired light-mediated strategy to determine *E. coli* perception of environmental factors critical to bacterial performance. The results we present are at the core of a larger synthetic biology research effort aimed at establishing a dialogue with bacteria. The framework is to convert the human voice into electric pulses, these into light pulses exciting bacterial fluorescent proteins, and convert light-emission back into electric pulses, which will be finally transformed into synthetic voice messages. We report here the first results of the project, in the form of a light-based determination of key parameters for bacterial comfort. The ultimate goal of this strategy is to combine different engineered populations to have a combined feedback from the pool.

***In vitro* activity of *Aloe vera* inner gel against *Helicobacter pylori* strains**

L. Cellini, S. Di Bartolomeo, E. Di Campli, S. Genovese, M. Locatelli and M. Di Giulio.

Aloe barbadensis Miller (*Aloe vera*) is a herbal remedy widely used for a variety of illnesses; *A. vera* leaf extracts have been promoted for detoxification, to cure constipation, to help flush out toxins and wastes from the body, to promote digestion and is also used in the

treatment of peptic ulcers for cytoprotective action. The aim of this study was to evaluate the antibacterial activity of *A. vera* inner gel against both susceptible and resistant *Helicobacter pylori* strains isolated in the Abruzzo region, Italy.

The study demonstrates that the *A. vera* inner gel expresses antibacterial properties against both susceptible and resistant *H. pylori* strains. These findings may impact on the antimicrobial resistance phenomenon of *H. pylori*, proposing the *A. vera* inner gel as a novel effective natural agent for combination with antibiotics for the treatment of *H. pylori* gastric infection.

Journal of Applied Microbiology

www.journalappliedmicro.com

Cross-talk between probiotic lactobacilli and host immune system

T. S. Kemgang, S. Kapila, V. P. Shanmugam and R. Kapila.

The mechanism by which probiotic lactobacilli affect the immune system is strain specific. As the immune system is a multicompartmental system, each strain has its way to interact with it and induce a visible and quantifiable effect. This review summarizes the interplay existing between the host immune system and probiotic lactobacilli, that is, with emphasis on lactobacilli as a prototype probiotic genus. Several aspects including the bacterial-host cross-talk with the mucosal and systemic immune system are presented, as well as short sections on the competing effect towards pathogenic bacteria and their uses as delivery vehicle for antigens.

Clotrimazole as a pharmaceutical: past, present and future.

P. D. Crowley and H. C. Gallagher.

Clotrimazole is a broad-spectrum antimycotic drug mainly used for the treatment of *Candida albicans* and other fungal infections. A synthetic, azole antimycotic, clotrimazole is widely used as a topical treatment for *tinea pedis* (athlete's foot), as well as vulvovaginal and oropharyngeal candidiasis. It displays fungistatic antimycotic activity by targeting the biosynthesis of ergosterol, thereby inhibiting fungal growth. As well as its antimycotic activity, clotrimazole has become a drug of interest against several other diseases such as sickle-cell disease, malaria and some cancers. It has also been combined with other molecules, such as the metals, to produce clotrimazole complexes that show improved pharmacological efficacy. Clotrimazole is a very well-tolerated product with few side effects, although there is some drug resistance appearing among immunocompromised patients. Here, we review the pharmaceutical chemistry, application and pharmacology of clotrimazole and discuss future prospects for its further development as a chemotherapeutic agent.

Microbial Biotechnology

www.microbialbiotech.com

Salmonid alphavirus replication in mosquito cells: towards a novel vaccine production system

M. C. Hikke *et al*.

Salmonid alphavirus (SAV) causes pancreas disease and sleeping disease in Atlantic salmon (*Salmo salar*) and rainbow trout (*Oncorhynchus mykiss*), and confers a major burden to the aquaculture industry. A commercial inactivated whole virus vaccine propagated in a salmon cell line at low temperature provides effective protection against SAV infections. Alphaviruses (family *Togaviridae*) are generally transmitted between vertebrate hosts via bloodsucking arthropod vectors, typically mosquitoes. SAV is unique in this respect because it can be transmitted directly from fish to fish and has no known invertebrate vector. Here, we show for the first time

that SAV is able to complete a full infectious cycle within arthropod cells derived from the Asian tiger mosquito *Aedes albopictus*. Progeny virus is produced in C6/36 and U4.4. cells in a temperature-dependent manner (at 15°C but not at 18°C), can be serially passaged and remains infectious to salmonid Chinook salmon embryo cells. This suggests that SAV is not a vertebrate-restricted alphavirus after all and may have the potential to replicate in invertebrates. The current study also shows the ability of SAV to be propagated in mosquito cells, thereby possibly providing an alternative SAV production system for vaccine applications.

Synthesis of novel bioactive lactose-derived oligosaccharides by microbial glycoside hydrolases

M. Díez-Municio, M. Herrero, A. Olano and F. J. Moreno.

Prebiotic oligosaccharides are increasingly demanded within the food science domain because of the interesting healthy properties that these compounds may induce to the organism, thanks to their beneficial intestinal microbiota growth promotion ability. In this regard, the development of new, efficient, convenient and affordable methods to obtain this class of compounds might expand even further their use as functional ingredients. This review presents an overview on the most recent interesting approaches to synthesize lactose-derived oligosaccharides with potential prebiotic activity paying special focus on the microbial glycoside hydrolases that can be effectively employed to obtain these prebiotic compounds. The most notable advantages of using lactose-derived carbohydrates such as lactosucrose, galactooligosaccharides from lactulose, lactulosucrose and 2-α-glucosyl-lactose are also described and commented on.

Melissa McCulloch
Wiley-Blackwell

Environmental Microbiology LECTURE 2014

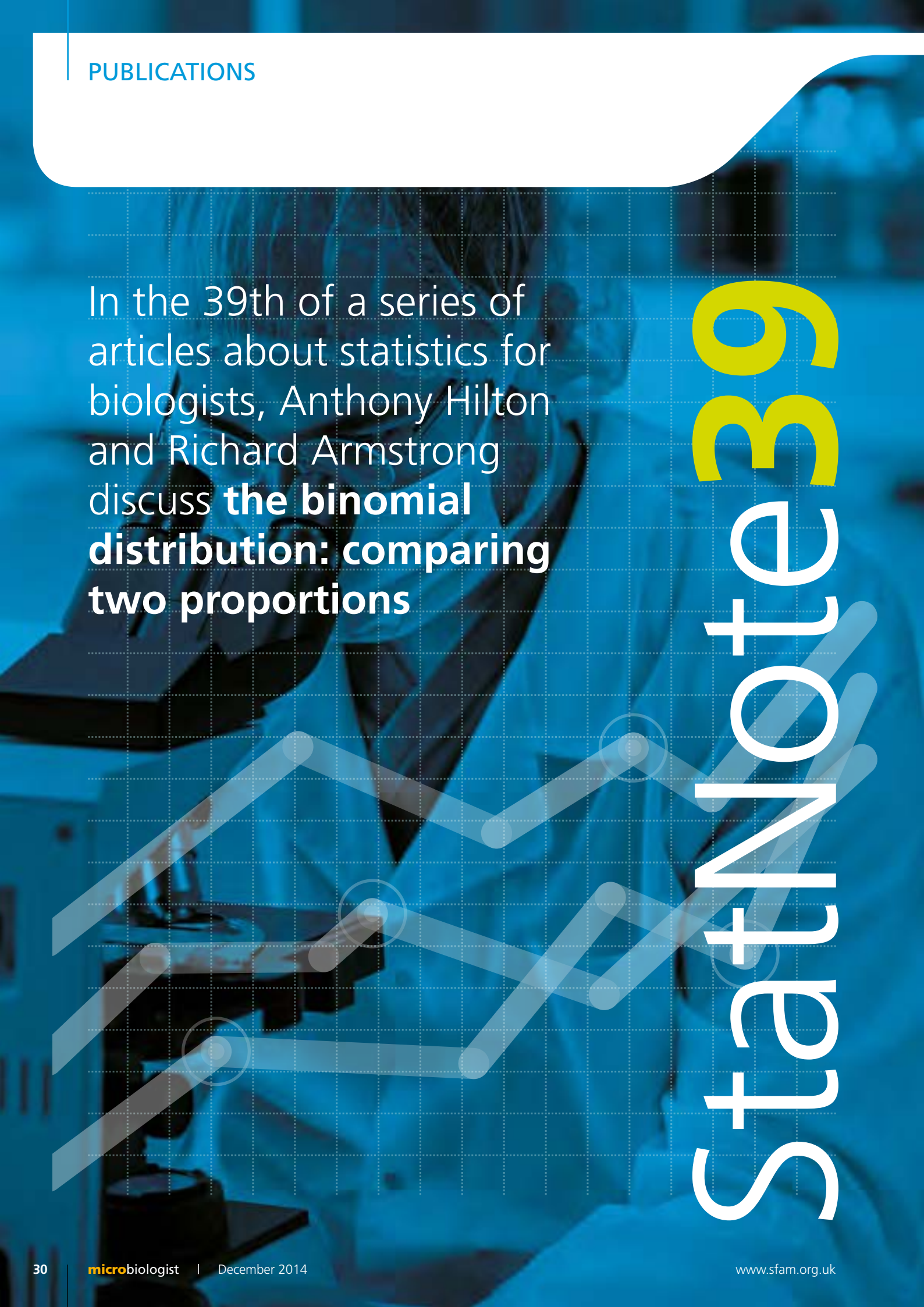
The Environmental Microbiology lecture was held at the

Royal Society of Medicine on **13 October 2014.**

Jim Prosser spoke to a packed audience about his work to develop new techniques for identifying species within the soil microbiome. He described how he has been able to delve into the world of nitrifiers to enable better understanding of various biogeochemical cycling processes.

If you were not able to attend the lecture, or you want to recap, there is a video available to watch here: **http://bit.ly/EMI_2014**.

'Unimaginable, unprecedented' microbial diversity: whence, so what and can we learn from nitrifiers?



Statistics 39

In the 39th of a series of articles about statistics for biologists, Anthony Hilton and Richard Armstrong discuss **the binomial distribution: comparing two proportions**

Introduction

Many populations consist of two classes only, e.g., alive or dead, present or absent, clean or dirty, infected or non-infected, and it is the proportion or percentage of observations that fall into one of these classes that is of interest to an investigator. An observation that falls into one of the two classes is considered a 'success' (S), and 'p' is defined as the proportion of observations falling into that class. If a random sample of size 'n' is obtained from a population, the probability of obtaining 0, 1, 2, 3, etc., successes is then given by the binomial distribution (Snedecor & Cochran, 1980).

The binomial distribution was derived originally from three basic rules of probability (Snedecor & Cochran, 1980). First, if a trial has 'k' equally likely outcomes, and only one outcome is possible, then the probability of that exclusive event will be 1/k. Second, if an event is satisfied by any one of a number of outcomes that are mutually exclusive, then the probability of the event is the sum of the individual probabilities of each event. Hence, the probability of 'drawing a vowel' from the first six letters of the alphabet (an 'a' or an 'e') is 2/6, and this is known as the 'additive rule'. Third, in a series of successive, independent trials, the probability that each of a specific series of events occurs is the product of the probabilities of each event and this is known as the 'multiplicative rule'. Hence, in a population of three elements, *viz*., a, b, c, the probability that two 'a' will be drawn in two independent successive trials is 1/3 x 1/3 = 1/9.

The binomial distribution can be used as the basis of a number of statistical tests but is most useful when comparing two proportions. This StatNote describes two such scenarios in which the binomial distribution is used to compare: (1) two proportions when the samples are independent and (2) two proportions when the samples are paired.

Scenarios

Comparing two independent proportions

To illustrate this test, we return to the scenario first introduced in StatNote 7 (Hilton & Armstrong, 2006). Meticillin-resistant *Staphylococcus aureus* (MRSA) is a significant cause of morbidity and mortality and, over the past two decades, has become a worldwide problem encouraged by the emergence of resistant isolates. Such isolates often demonstrate a reduced susceptibility to almost all clinically available antibiotics. It is generally accepted that it is sub-lethal exposure of bacteria to antibiotics that may have encouraged the rapid development of resistance and that this situation is more likely to have occurred in a hospital environment than in the community. It might be hypothesized, therefore, that isolates of MRSA obtained from a hospital (HA-MRSA) would demonstrate enhanced resistance to antibiotics compared with MRSA isolated from the community (CA-MRSA). Hence, the proportion of isolates from the hospital environment exhibiting resistance to five or more antibiotics should be greater than in the community environment.

To test this hypothesis, 197 isolates of MRSA consisting of 95, HA-MRSA and 102, CA-MRSA were isolated from soft tissue infections and screened for their sensitivity to a panel of 10 antibiotics using the British Society for Antimicrobial Chemotherapy (BSAC) disc diffusion method. Isolates were designated as resistant (R) or sensitive (S). If the hospital provides an environment promoting the development of antibiotic resistance, then it might be expected that HA-MRSA would demonstrate a greater than average spectrum of resistance (i.e., ≥ 5 antibiotics of the 10 screened) than those isolated from the community.

Comparison of two paired proportions

To illustrate the second scenario, the degree of effectiveness of two different cleaning regimes (A and B) was applied to hospital wards in England. The wards were first, paired as far as possible, on the basis of location, size, age and usage, and second, cleaning regime A or B was applied at random to the members of each pair of wards. The outcome of the trial was that a ward either passed (a 'success') or failed (a 'failure') the trial. If there was no effective difference in the success rate of the two cleaning regimes, then it would be expected that the proportion of pairs of wards in which A or B was scored as a success would be similar.

How were the tests carried out?

Theory

In a single trial, the probability of obtaining 'r' successes in a sample of size 'n' is given by expansion of the binomial expression $(q + p)^n$ where 'p' is the probability of a success and q = 1 – p the probability of a failure. If estimates are made from a random binomial sample of size 'n', the normal distribution can be used as an approximation to estimate the mean and standard deviation (SD) of the sample of successes 'r'. Hence, for the number of successes 'r':

mean (μ) = np, variance (σ^2) = npq,
SD (σ) = $\sqrt{npq}$ ..... (1)

Similarly, for the proportion of successes P(r) = r/n:

μ = p, σ^2 = pq/n, $\sigma = \sqrt{pq/n}$ ..... (2)

The binomial is a discrete distribution whereas the normal distribution describes a continuous quantitative variable (StatNote 2, Hilton & Armstrong, 2005). Hence, to use the normal distribution in this context, a 'correction for continuity' is usually applied to these tests (StatNote 7, Hilton & Armstrong, 2006).

	HA-MRSA	CA-MRSA	Total
Resistant to ≥ five AB	42	5	47
Resistant to ≤ five AB	53	97	150
Total	95	102	197
Proportion resistant to five AB	$p_1 = 0.44$	$p_2 = 0.049$	$p = 0.2385$

1. *Calculate an estimate of overall 'p' from the totals: $p = 47/197 = 0.2385$, therefore $q = 1 - p$.*
2. *Calculate: $Z = p_1 - p_2 / \sqrt{[pq(1/n_1 + 1/n_2)]} = 7.0$ ($P < 0.001$).*
3. *Hence, the proportion of isolates from a hospital environment (HA) exhibiting resistance to more than five antibiotics is significantly greater than from the community environment (CA).*

Table 1. *Is the proportion of MRSA isolates from a hospital environment (HA) exhibiting resistance to more than five antibiotics greater than in the community environment (CA)?*

Comparison of two independent proportions

The proportion of isolates from a hospital- and community-based environment exhibiting resistance to more than five antibiotics is shown in Table 1. This analysis is analogous to that of the chi-square (χ^2) test carried out on a 2 x 2 contingency table described in StatNote 7 (Hilton & Armstrong, 2007). Hence, if the two proportions are not significantly different and are normally distributed, the difference between them will also be normally distributed with a mean of zero and a standard error (SE) given by:

$$SE = \sqrt{(pq/n_1 + pq/n_2)} \quad \text{..... (3)}$$

Hence,

$$Z = p_1 - p_2 / \sqrt{[pq(1/n_1 + 1/n_2)]} \quad \text{..... (4)}$$

This calculation gives a value of Z = 7.0 and a value of P < 0.001, and hence, we conclude that there is an association between the antibiotic sensitivity profile of an isolate and its location, greater resistance being observed in the hospital setting. In this example, the difference between the two proportions is several times greater than its SE, and a correction for continuity would not be necessary. However, if the sample was small and if $n_1 = n_2$, 'Z' could be corrected for continuity by subtracting 0.5 from the numerator of the larger 'p' and adding it to the numerator of the smaller 'p'. In studies employing small samples or with unequal sample sizes the χ^2 test or, with a very small sample, Fisher's 2 x 2 exact test are useful alternatives (see StatNote 7, Hilton & Armstrong, 2007).

Comparison of proportions in paired samples

The proportion of successes of the two cleaning regimes A and B applied to pairs of hospital wards is shown in Table 2. Hence, in 52 pairs of wards, both cleaning regimes were scored as a success, in 21 pairs, method A was scored as a success and B a failure etc. To carry out the test, the pairs of wards in which both regimes were scored as a success (S) or as a failure (F) were ignored as they give no indication of which regime was more favourable than the other. If the null hypothesis is true, however, then the proportion of pairs of wards scoring either regime A or B as a success should be equal, i.e., $N_{SF} = N_{FS}$ and this can be tested using a 'Z' or χ^2 test:

$$\chi^2 = \{|N_{SF} - N_{FS}| - 1)2/(N_{SF} + N_{FS}) \text{ with 1 degree of freedom (DF) ..... (5)}$$

In Table 2, a value $\chi^2 = 4.03$ was obtained which is greater than the critical value at P = 0.05 for 1 DF. Hence, the null hypothesis is rejected and it is concluded that cleaning regime A did result in a higher proportion of successes than regime B. This test often concerns investigators as it does not appear to use all the available data. Hence, the total sample size 'n' does not appear explicitly in the calculation of 'Z' or 'χ^2' and equally, the N_SN_S and N_FN_F data were ignored in the calculation. This circumstance arises, however, as a consequence of the pairing of the data and exactly the same result would be obtained if the two proportions were compared directly, i.e., by dividing the difference between the two proportions by its SE and treating the result as a member of the normal distribution (Snedecor & Cochran, 1980).

Outcomes		
A	B	Number of pairs
S	S	52
S	F	21
F	S	9
F	F	18

1. *Ignore the frequencies of the SS and FF outcomes.*
2. *Calculate: $\chi^2 = \{|N_{SF} - N_{FS}| - 1)2/(N_{SF} + N_{FS}) = 4.03$, $P < 0.05$ for 1DF.*
3. *Hence, the null hypothesis is rejected, i.e., cleaning regime A was more successful than B.*

Table 2. *Do two different cleaning regimes (A or B) produce an equal number of successful outcomes (S = success, F = fail) when applied to pairs of similar hospital wards in England?*

Estimating sample size for comparing two proportions

It is also possible to estimate the sample size necessary to compare the difference between two proportions and the procedure is described by Snedecor and Cochran (1980). Suppose in a test, a standard antibiotic protects about 50% of animals against an infectious disease and it is desired to compare this performance against that of a new antibiotic believed to be superior. What sample size would it be appropriate to use in this scenario to give a high probability of a significant result if the new antibiotic protects at least 80% of the animals? As an illustration, assume a high probability (say a 'ß' level of 0.90) of demonstrating a significant difference in a 1-tail test where an 'α' level of 0.05 is required. In this scenario, for two independent samples, 'n' is given by:

$$n = (Z_\alpha + Z_\beta)^2[(p_1q_1 + p_2q_2)/(p_2 - p_1)^2 \quad \ldots\ldots (6)$$

$(Z_\alpha + Z_\beta)^2$ can be obtained for common values of α and ß from Table 6.14.1 in Snedecor and Cochran (1980), which gives a value of 8.6. This value can then be substituted into equation 6:

$$\text{hence, } n = (8.6)[(50)(50) + (80)(20)]/(30)^2$$

Which gives a value of n = 39 and hence, approximately 40 animals in each group would be an appropriate sample size.

Conclusions

The normal approximation to the binomial distribution can be used as the basis of some useful statistical tests involving proportions and is an alternative to the X^2 contingency table test described in StatNote 7 (Hilton & Armstrong, 2006). Paired and independent proportions can be compared using either the X^2 or 'z' distributions. In addition, estimates of the sample size necessary to give a high P of demonstrating a significant difference between two proportions can be calculated.

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SUMMER CONFERENCE Report **2014**

*This year's Summer Conference took place at The Grand Hotel in Brighton from Monday 30 June to Thursday 3 July. The theme for the conference was '**Zoonoses**' and it was a joint conference between Med-Vet-Net and SfAM.*

*The pre-conference workshop was on '**International zoonoses collaboration**' and proved very informative. The conference then formally started with the Annual Journal of Applied Microbiology Lecture.*

Monday 30 June

Journal of Applied Microbiology Lecture

The *Journal of Applied Microbiology* Lecture has become a highly anticipated start to the Summer Conference, and this year the Empress Room was filled, we were welcomed by our President, Martin Adams, who introduced us to the lecture. The 2014 *Journal of Applied Microbiology* Annual Lecture was delivered by Professor George Macfarlane of the University of Dundee, School of Medicine, whose research focuses on inflammatory bowel disease, aging and microbial invasion of the upper gut, and spoke on the fascinating topic of bacterial metabolism and of its consequences for the host.

The lecture started by looking at the amount of bacteria in the gut. Although some of us may have previously believed that there may be 1–1.5kg of bacteria in the large bowel, George Macfarlane quickly dismissed that to be a fallacy and by presenting data from a series of studies from over 25 years from Cambridge and Soweto, South Africa, we were informed that the true figure was more likely to be around 40–50g. George's evident interest in the topic was highlighted when he declared that this made the gut microbiota a lot more exciting, because of the level of metabolism going on with far fewer bacteria than expected. Indeed, George described the metabolic diversity of the microbiota, as recent studies have shown that there are 3,000,000 genes in the gut microbiome compared with 23,000 genes in the human microbiome; many of which are believed to be new and their function unknown.

The diversity of bacterial processes that go on in the gut were discussed, these are not only protein and carbohydrate breakdown, but include a range of activities which all have an effect on the metabolism and health of the host. George highlighted that there are a whole range of processes that occur within the human gut which include biochemical activities, formation of genotoxic, mutagenic and carcinogenic agents, and the formation of precursor compounds.

Factors that affect bacterial metabolism in the colon were clearly categorized according to host and bacterial factors; however, the diet of the host was described as the most important driving force in regulating the structure and metabolic activities of the colonic microbiota. With regards to bacterial factors, the types and quantities of bacteria present not only affect function, but also the ingress of other species.

The large intestine was said to be probably the most proteolytic natural environment known as each day 4g of pancreatic endopeptidase go into the large bowel, most of which is broken down by the bacteria. When discussing the types and amount of fermentation substrates in the large bowel, although the major sources of carbon and energy were resistant starches and non-starch polysaccharides, George explained that the diversity of carbon and energy sources available for

the bacteria supports a diverse species population in the colon. The complex microbiota in the large bowel is structurally and metabolically diverse with over 1,000 species of bacteria reported to be present. Data on gut contents of sudden death victims was used to explain the process of metabolism in the large bowel which occurs by either the glycolytic pathway or the pentose phosphate pathway.

There has been a lot of interest in energy generation from short chain fatty acids in the gut due to research looking at obesity and microbiotas; George explained that short chain fatty acids alone could not explain why an individual may be obese, as data indicate that 400mmol of short chain fatty acids are produced each day which equates to around 5% of the host's daily requirements. Although getting 5% of our daily requirements from carbohydrate fermentation in the gut is not a great deal for someone living on a Western-style diet, however, it could mean life or death for someone that is starving in a Third World country, as the majority (95%) of fatty acids are absorbed by the large bowel and are metabolized by the host. Molar ratios of short chain fatty acids were shown to vary across sites in the body, which is due to the fact that different fatty acids produced by different bacteria in the large bowel are cleared in different body organs.

Branched chain fatty acids were described as being excellent markers of fatty acid production from proteins and *in vitro* modelling studies indicate that around 30% of all fatty acids derived from proteins are branched chain fatty acids. However, this varies from 17% of all short chain fatty acids in the proximal colon arising from protein, up to 38% in the distal colon which indicates a change from carbohydrate to protein digestion by bacteria between the proximal and distal colon. Furthermore, the percentage of branched chain fatty acids was calculated at different pH levels.

Due to carbohydrate fermentation, the pH of the proximal bowel is more acidic than the distal colon, which explains why fewer protein breakdown products accumulate in the proximal gut as the proximal bowel proves to be very metabolically active.

Interestingly, between 0.5–4.0 litres of hydrogen are produced in the bowel each day, most of which is lost through breath, however much is cross fed by other species. A study in which volunteers consumed sulfate with meals determined that methane production dropped during sulfate consumption, which indicates the effect that small changes in the diet can have big metabolic effects on some bacterial populations in the gut.

It was also fascinating to hear George discuss the difficulties experienced in obtaining some of the samples that some of the data had originated from and we all shared in his humour during the lecture, particularly in his cartoon summary of fermentation in the gut.

Monday concluded with a drinks reception and the ever-popular quiz night.

Ellen Evans

Tuesday 1 July

SESSION 1: Risk Research

The first conference session, **Risk research**, started on Tuesday morning. The first speaker of the day Arie Havelaar, National Institute for Public Health and the Environment, and University of Utrecht, gave a fascinating talk on '***The influence of acquired immunity and dose-dependent probability of illness on the risk assessment of Campylobacter jejuni***.' Arie's talk presented findings from a recent study on microbial risk assessment which, had considered two steps, exposure to infection and infection to illness, as well as acquired immunity in the process leading to actual illness. Arie's team had found that at low doses the inclusion of the infection to illness step had the greatest impact on risk estimates whereas at higher doses the inclusion of an inflation factor representing acquired immunity had the greatest impact. The team hope that this study can form the basis for further development of microbial dose-response modelling.

Sara Monteiro Pines, Technical University of Denmark, provided the next talk on '***Uncovering the real burden of foodborne diseases: integrating burden of disease and source attribution***'. Sara discussed the importance of identifying and prioritizing interventions to reduce the burden of foodborne disease and some of the challenges to this. Sara went on to discuss recent developments in measuring disease burden which help with comparisons of the burdens of very different disease entities including the development of metrics such as disability adjusted life years (DALYs). Sara then discussed The Food Burden project which uses a one health approach to try to uncover the real burden of foodborne disease and to use these data to estimate the most important sources of disease and to prioritize hazards.

The next speaker for the morning session was Andrew Hill, AHVLA who presented '***Modelling the species jump: assessing the risk of zoonotic influenza infection***'. Andrew's talk looked at influenza A and a new risk assessment framework designed to rank influenza A viruses circulating in animal populations based on their ability to jump the species barrier. They then used this to estimate the chance of at least one person getting infected within a 5km area to create a ranked list of animal viruses with the potential to be pandemic.

The final speaker in the '**Risk research**' session was Annemarie Kaesbohrer, National Reference Laboratory for Antimicrobial Research. Annemarie's talk focused on '***Source attribution of ESBL – E. coli – what is the contribution of livestock to the public health risk?***' Annemarie covered the increasing public health problem of ESBL-producing *E. coli*. She talked about the use of the microbial subtyping approach to compare isolates from different sources with subtypes isolated in humans. Annemarie's talk focussed on the results of the studies from RESET Research Consortium which had estimated the prevalence of ESBL-producing *E. coli* in livestock populations as well as in the community and hospitalized cases. The resulting isolates were then typed.

After a fascinating morning of lectures we broke for lunch ready for the next session.

Clare Doggett

SESSION 2: Host pathogen interactions

Host pathogen interactions were addressed in Session 2 which was chaired by the President of the Med-Vet-Net Association, Roberto La Ragione.

In the first talk, '***Understanding the virome in 'one' health and disease***', Jonathan Heeney, University of Cambridge, UK, summarized the important issues regarding the study of the virome, which has lagged behind that of the bacterial genome.

Defining the virome requires consideration of anatomical regions beyond the gut such as the liver and peripheral blood. Zoonotic infections are becoming better understood and we now know that SIV-related morbidity and mortality in chimpanzees is higher than previously thought. The need for computational scientists has become apparent in order to analyse the results from studies such as the one described by Jonathan investigating the virome of three cohorts of immunosuppressed patients: those with primary immune deficiencies, intra-venous drug users and kidney transplant patients.

Rick Titball, University of Exeter, UK, presented the next talk, '***Alternative models for the assessment of virulence***'. He focused on the use of *Galleria mellonella* larvae which produce melanin pigment when diseased. Their use as a model for *Campylobacter jejuni* virulence required so many larvae that equivalent investigations using mice would have been impractical. They have also been used to track the behaviour of mutants.
A further study using *G. mellonella* involved the use of non-pathogenic *Burkholderia thailandensis* to model human infection with *Burkholderia pseudomallei*. The pharmacokinetics of ceftazidime, the drug-of-choice for melioidosis, was monitored. Additionally, novel compounds have been investigated before being tested in mouse models.

A limitation of these larvae is the lack of quality control so the use of a single supplier would be an advantage.

'***Colonization of MRSA on porcine nasal mucosa***' was the title of the third talk, presented by Birgitta Duim, University of Utrecht, The Netherlands. She described the application of *ex vivo* porcine nasal mucosa explants to monitor the adaptation of MRSA ST398 during colonization. There is now a large reservoir of this organism in Dutch pig farms which is transmitted between pigs and from sows to their offspring.

The colonization efficiency was found to differ between strains but was not accompanied by significant changes in the transcription of major virulence-associated genes. In particular, *vwbp* and *scpA* were not found to play a crucial role.

Paulo Pasquali, Istituto Superiore di Sanita, Rome, Italy, delivered the final talk of the session, '***Salmonella enterica serovar Typhimurium exploits inflammation to survive and multiply in piglets***'. Inoculation of three groups of piglets with a virulent strain of *Salm*. Typhimurium, an attenuated strain and saline showed that the virulent strain induced mediators of inflammation as well as other markers of infection. These mediators are more effective against the normal microbiota than against salmonellae thus enhancing the survival of the pathogenic *Salm*. Typhimurium. A further study in which post-weaned piglets were injected with the virulent strain, with and without LPS, showed that the production of cytokines, body temperature and bacterial burden were all higher in the presence of LPS, supporting the idea that salmonellae exploit the immunological response to infection for their own survival.

The need for **computational scientists has become apparent** in order to analyse the results from virome studies

STUDENT SESSION: CV Workshop

Next up was this year's student session, organized by the Postgraduate and Early Career Scientist (PECS) Committee, a CV workshop. The PECS Committee gathered a range of experienced mentors, to provide advice to the student and early career scientist attendees on how to improve their CVs and cover letters. We were incredibly grateful to the mentors involved, who gave excellent advice, and were as follows: Christina Keiller, Careers Counsellor, University of Brighton; Jo Bevan, Careers and Volunteering Advisor, University of Brighton; Sarah Maddocks, Academic, Cardiff Metropolitan University; Ali Ryan, Reseacher, Kingston University; Nancy Mendoza, SfAM Communications; Clare Taylor, Academic, Edinburgh Napier University; Nick Jakubovics, Academic, Newcastle University; Claire Hill, Clinical Product Manager, Medical Wire; Mark Reed, European General Manager Pro-Lab and Lynn Mcintyre, Academic, Harper Adams University. The session was very well received, with a large number of student, postgraduate and early career scientists seeking advice.

The event had a relaxed but professional atmosphere, allowing mentors to pass on their collective knowledge on a one-to-one basis, whilst also facilitating group discussions. It was refreshing to see and take part in exchanging tips for CV writing with other PECS members too. Some of the attendees earlier in their careers appreciated the opportunity to talk to and receive advice from more experienced PECS members. Attendees were impressed with the range of mentors available, and just how approachable and friendly everyone was. Many students cannot make the time to seek CV advice whilst at university, so this session provided a convenient opportunity for them. In addition to CV advice, the topic of several conversations moved towards interviews, and of course the mentors also proved to have a wealth of knowledge to share here too. I personally found this event incredibly useful, and speaking to a number of attendees, the feeling was mutual throughout the room. Not only did this event help to further break the ice between the PECS attendees, but hopefully it helped many of them to enhance their CVs, and therefore enhance their chance of future employment.

Louise Hill-King

Stewart Barker

Wednesday 2 July

SESSION 3: Epidemiology and surveillance

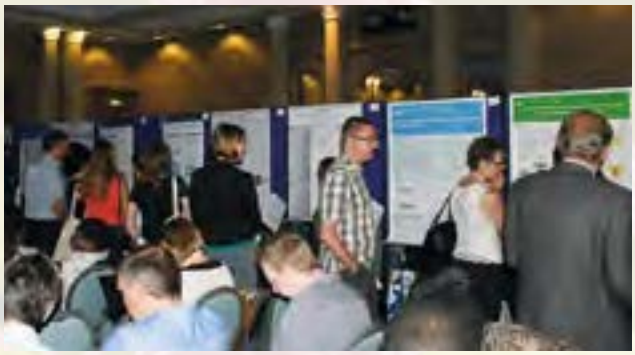
Katarina Stärk (Royal Veterinary College) opened Wednesday morning's session with an informative discussion of the key constraints on efficient surveillance that are imposed by policy and the availability of resources. Effective surveillance includes not only the well-known technical aspects of data collection and analysis but also the impact of the data, including how it should be used to bring about change. Surveillance may be based on economic efficiency to obtain the best possible cost/benefit ratio, or it may be risk-based, in which case the level of risk is used to set priorities. With either approach, surveillance must be linked to actions or interventions in order to be effective. Policies pertaining to surveillance are set by several different bodies, including the European Commission, the WHO and others, and funding tends to follow the specific details of the policy. Katarina gave an important example where an effective surveillance of wild bird populations for avian influenza using 'sentinel' species does not receive funding as it is not included in the relevant policy document. It is essential that scientists and policymakers have appropriate dialogues in order to produce effective, evidence-based surveillance policies.

The next talk by **Käre Mølbak** (Statens Serum Institut, Copenhagen, Denmark) covered the use of seroepidemiology to measure the force of infections in humans by foodborne pathogens. Reported cases of foodborne infections are just the tip of the iceberg. To estimate the true incidence of infections it is necessary to screen populations for seroconversion post-infection. Using a mathematical model to back calculate the seroincidence from measurements of specific antibodies, it was possible to determine seroincidence rates in different European countries by screening 10,000 patient samples for antibody levels. For *Salmonella*, the measured seroincidence in different European countries varied around 10-fold and correlated with both the prevalence of *Salmonella* in laying hens and the level of country-specific risk of *Salmonella* infections to Swedish travellers. Therefore, seroincidence is a powerful tool to measure the force of transmission of *Salmonella* to humans. By contrast, for *Campylobacter*, the seroincidence did not correlate with prevalence in broiler carcasses, possibly because seroconversion arises following exposure to *Campylobacter* from environmental sources.

Tim Dallman (Public Health England) followed with a fascinating description of data from some of the earliest whole genome sequencing (WGS) projects run by PHE. Potentially, WGS is a very powerful way to track the spread and find the cause of infectious disease outbreaks. It provides an exquisite level of discrimination that is essential for tracking the spread of clonal populations, and has other advantages including being quick and relatively easy to standardize. *Salmonella* was chosen for one of the first WGS efforts since it is difficult to type reliably in the laboratory and, on a practical level, WGS circumvents the requirement for a Containment Level 3 laboratory for typhoid strains of *Salmonella*. The application of WGS has provided detailed information on different *Salmonella* isolates, including enabling an estimate of the date of divergence of certain pathogenic isolates. It is likely the WGS will be used increasingly within the diagnostic services provided by PHE. Nevertheless, there are significant challenges, such as cost and quality control that still need to be addressed.

It is essential that **scientists and policymakers have appropriate dialogues** in order to produce effective, evidence-based surveillance policies

Nick Jakubovics



After a short coffee break we continued with an interesting talk by Dik Mevius, CVI Lelystad, on '***Preventing ESBLs in the food chain***'. Dik began his presentation with a short introduction to ESBLs before introducing the idea that they were a 'one health' problem – bacteria from livestock, wildlife and companion animals being passed to humans and then passed between humans. Dik went on to discuss possible intervention policies and prevention options including reducing the use of antibiotics in livestock.

Next Laura Piddock, University of Birmingham, discussed '***Antibiotic resistance in Salmonella: from phenotype to genotype and back again***'. Laura's talk focused on a long-term study her team had been undertaking looking at clinical isolates of *Salmonella enterica* serovar Typhimurium from a patient who had been hospitalized in the 1990s and had failed antibiotic treatment. Laura explained how their early research had been hampered by lack of whole genome sequencing and how developments in genomics had transformed their research.

The final lecture for this session was given by Sam Sheppard, University of Swansea, on '***Genome-wide association studies in bacteria: Campylobacter survival in the non-host environment***'. Sam explained that whilst whole genome sequencing had provided huge new opportunities in understanding bacterial epidemiology and evolution there were still huge challenges for analysing the data. Sam went on to discuss some of the new approaches in analysing the data and some of the challenges and successes. He then went on to present his team's work on a new data analysing method that they had used to investigate genetic variation in *Campylobacter* in the food chain.

STUDENT SESSION: Student oral presentations

As a student researcher you find a lot of people telling you '*that oral communication skills cannot be taught and the more presentations that you do the better you get*'. So when I sat down in the Student Session to hear the presentations I was extremely pleased by the high standard from the Student Members.

The session was introduced with a lovely talk by Anne Ammerdorffer on the recognition of *Coxiella burnetii* Nine Mile and the Dutch outbreak isolate 3262.

Jemima Ho then gave a well-written presentation discussing the signalling of influenza virus-infected respiratory cells upon macrophages regulating pathogenesis in human cells. This later saw her win best oral presentation and was definitely well deserved. More interesting talks followed with Rie Jonsson discussing the characterization of a novel adhesin in enteroaggregative *E. coli* (EAEC) and Laura Grandet speaking on VTEC O157 transmission of infections to humans and how subpopulations could be adapted to the animal reservoir.

Zara Gerrard's talk was one that left the best impact in my memory. Her twist during the introduction to her research, based on methods of detecting *Mycobacterium avium* subspecies in controlling Johne's disease in cattle, had me interested from the very start.

Rahaf Issa spoke impressively on the poly(ε-lysine) dendron and its role in biofilm formation in *Pseudomonas aeruginosa*. Louise Birse gave a talk close to my heart on transcriptomic analysis of enterohaemorrhagic *E. coli* O157:H7 in response to plant extracts, highlighting the different metabolic pathways induced upon exposure to polysaccharides from different plant species.

By the end of the session I realized that I was not alone in feeling impressed by the session's talks, but that the whole of the Empress room filled with students, academics and industry experts alike, all had the same feeling. It was so nice to hear someone who attended the session go back and tell her colleagues at dinner how great it was and to hear people leave emphasizing that the session was time well spent and these actions truly summarized how brilliant a Student Session it was.

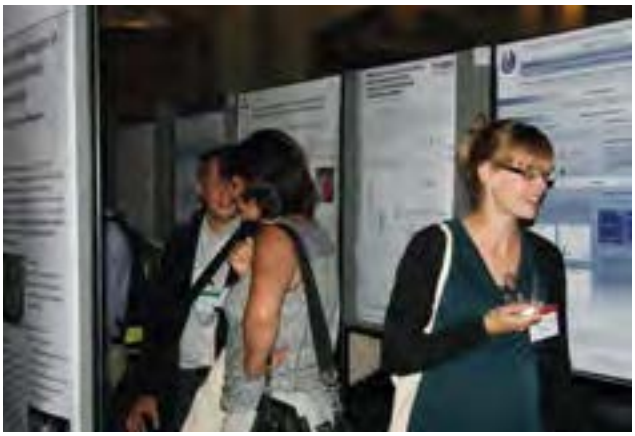
Clare Doggett

Sabrina Roberts

This method could be used to assess the production of high-quality and safe food

SfAM Award Lectures

The first of the SfAM Award Lectures was given by Douglas Fraser-Pitt (NovaBiotics Ltd, UK) who received the New Lecturer Research Grant from SfAM in 2011. Douglas gave a fascinating presentation on '***Biofilms, biocides and buttercups***'. A 'cheap' MSc project in 2010 led to the discovery that aqueous extracts from *Ranunculus acris* (a common meadow buttercup) were capable of inhibiting adherence and biofilm formation in a number of microorganisms. Support from the SfAM New Lecturer Award enabled further investigation into the bioactives of this aqueous extract, and compounds isolated from it, against the biofilm-forming opportunistic pathogen, *Pseudomonas aeruginosa*. Ranunculin, an unstable glucoside, was the single purified component of the aqueous extract which was able to prevent biofilm formation. Douglas explained how ranunculin also inhibited fluorescence in *Vibrio fischeri*, which, when combined with other results, suggested inhibition of the quorum-sensing regulation of biofilm formation and pyocyanin production. It was found that the buttercup extract itself was inhibiting bacterial attachment/biofilm formation only, and wasn't antimicrobial. But when the enriched extract was examined, it was found to be antimicrobial, which was probably due to enrichment of the active components. Research on ranunculin has been difficult to progress due to its instability and its rapid breakdown into protoanemonin and glucose etc., however there will be further investigation. Douglas concluded his presentation by noting that this research grant has led to new collaborations and other projects.



The W H Pierce Prize was awarded to Vasillis Valdramidis of the University of Malta, Malta. In the talk, '***Integrating principles of predictive microbiology in food processing***', Vasillis discussed how mathematical models can be developed to describe the behaviour of microorganisms given certain environmental conditions. The models described enable the prediction of microbial behaviour in real food products. Therefore, this method could be used to assess the production of high-quality and safe food products that have fewer additives and are nutritionally healthier through the replacement of severe thermal treatments. Vasillis gave an overview of thermal and non-thermal technologies, for example, the high hydrostatic pressure of meat products and the effect of high-power ultrasound on infant milk formula. The application of qualitative probabilistic and quantitative microbial studies for defining the stability of apple juice was presented as a representative case study. The aim of this was to assess the efficiency of ozonation for preserving fruit juices and characterizing the mechanism of microbial reduction. It was found that the efficacy of ozone treatment was a function of the pH of the apple juice and the shelf life of ozone-processed apple juice can increase significantly. It was also noted that cell lysis was not the major mechanism of microbial inactivation. Vasillis concluded that when assessing thermal and non-thermal processes integrated information from the field of microbiology and food processing should also be considered. The afternoon concluded with the AGM and then the conference dinner.

Samantha Law

Thursday 3 July

SESSION 4: Detection and control of neglected and emerging zoonoses

The excellent scientific momentum was maintained through to the final session that explored "hot topics" for detection and control of neglected and emerging zoonoses. Wim van der Poel from the Central Veterinary Institute in The Netherlands, opened this session with an overview of some of the recent emerging viruses that have had a major impact upon humans including Hendra, MERSCoV and Ebola virus. Technical advances facilitated by molecular approaches have provided a means of screening for potential causative agents. Using microarrays, high-throughput screening of more than 1,200 viral species is possible on a range of different clinical samples. Metagenomic approaches using next generation sequencing have enabled pathogen discovery such as for Kobuvirus that affected both cattle and pigs recently in The Netherlands. Several pan-European projects have enhanced surveillance capacity such as WildTech and Epizone, and more recently a sequencing based initiative for foodborne and zoonotic pathogens.

We were then given insights into the newsworthy emerging new coronaviruses by Astrid Vabret from University Hospital Caen, France. This group contains both SARS and MERS, both of which have resulted in grave concerns over public health as a result of their high mortality rates and associated multi-million dollar costs (SARS is estimated to have had a 30–60 billion dollar legacy alone). These enveloped positive sense RNA coronaviridae are a highly genetically diverse group, largely through their ability to evolve through insertion, deletion and recombination events. As a result, they often result in persistent infection through their presence as a quasispecies. They have a wide natural host range, but bats have been hypothesized to be the likely source of these viruses, however, their ability to infect dromedary camels facilitates greater "spill-over" opportunities for human infection. Their impact is not limited to human infection as this group have immense veterinary implications too. Currently, a highly pathogenic porcine epidemic diarrhoea virus (PEDV) has emerged from the United States and is associated with 80–100% mortality rates among suckling piglets. This virus claimed some 8 million pigs in 30 states of America in 2013!

Continuing with our viral zoonotic theme, we were then introduced to the ecological dynamics that influence transmission of tick-borne Crimean-Congo haemorrhagic fever virus (CCHF), given by Agustin Estrada-Pena, University of Zaragoza, Spain. The CCHF virus is transmitted by ticks belonging to the *Hyalomma* genus, though favouring warm climates, some *Hyalomma* ticks are found in Europe, thus raising potential for the spread of CCHF, however this also requires the correct host diversity to facilitate effective transmission. We then explored some of the anthropogenic factors such as changes in land use and roaming livestock and of course weather change, that affect tick and viral distribution. New introductions can be facilitated via migratory birds or livestock movements. Modelling methods have been used to assess the risk that sustainable foci of infection will establish, however, a limitation of these methods is habitat "fragmentation" of ecologically suitable habitats, underscoring the need to integrate biological, ecological and mathematical approaches.

The final presentation returned us to probably the most classical viral zoonoses, rabies. Ashley Banyard from AHVLA, UK, addressed the question as to whether rabies can be eradicated using a "one health" approach? He initially introduced us to the rabies virus, and the disease that has plagued mankind for centuries. Despite a protective vaccine being available, this virus still claims the lives of 59,000 per year including about 100 children per day! Despite this, research and eradication programmes are poorly supported, thus rabies is considered to be a neglected zoonotic disease. Rabies control has several notable successes such as the vaccination of foxes in Europe and the reduction of dog rabies facilitated through vaccination. To achieve such reductions requires international collective efforts. Sadly, most infection remains in those areas least able to support eradication campaigns necessitating global support and political commitment. Given such opportunities, eradication of canine rabies is a possibility, however, the extensive wildlife reservoir in bats will hamper true eradication efforts.

The conference was a huge success with delegates commenting on the high-quality science as well as the enjoyable social events.

Sally Cutler

14 January 2015, The Royal Society, London

*Sf*AM Winter Meeting

14 January 2015

10:00 – 10:30	**Tea, coffee and registration**
Chair:	Christine Dodd, S*f*AM *President*
10:30 – 11:15	**The Denver Russell Memorial Lecture: *Vibrio vulnificus*: a killer lurking on our beaches?** James Oliver, *University of North Carolina, USA*
11:15 – 11:50	**Urban UK flood water: microbiology and much, much more** Lorna Fewtrell, *Aberystwyth University, UK*
11:50 – 12:25	**Potential microbiological risks in recreational water activities** Frances Lucy, *Institute of Technology, Sligo, Ireland*
12:25 – 13:30	**Lunch**
Chair:	*TBC*
13:30 – 14:05	**Contamination of bivalve shellfish with enteric viruses** David Lees, *Centre for Environment, Fisheries and Aquaculture Science, Weymouth, Dorset, UK*
14:05 – 14:40	**Microbial risks associated with spring waters and private supplies** Paul Hunter, *University of East Anglia, UK*
14:40 – 15:00	**Tea and coffee**
15:00 – 15:35	**Biofilm problems in dental unit water systems and its practical control** David Coleman, *University of Dublin, Ireland*
15:35 – 16:10	***Pseudomonas* in hospital waters** Jimmy Walker, *Public Health England, UK*

Water, water everywhere
but is it safe?

*Sf*AM Spring Meeting

16 April 2015

The Sheffield Hilton, Sheffield, UK

9:30 – 10:00	**Tea, coffee, trade exhibition and registration**
Chair:	TBC
10:00 – 10:40	**New developments in antimicrobial resistance** Neil Woodford, *Antimicrobial Resistance and Healthcare Associated Infections Reference Unit, PHE Colindale, UK*
10:40 – 11:20	**Current issues in medical mycology** Elizabeth Johnson, *PHE Mycology Reference Laboratory, Public Health England South West Laboratory, Bristol, UK*
11:20 – 12:00	**What's new in the diagnosis of tuberculosis** Tim Brown, *PHE National Mycobacterium Reference Laboratory, UK*
12:00 – 13:10	**Lunch and trade exhibition**
	Case studies in clinical microbiology
Chair:	*TBC*
13:10 – 13:35	**Study 1: *Strongyloides sp* – An unusual treatment** Dave Partridge, *Sheffield Teaching Hospitals NHS Foundation Trust, UK*
13:35 – 14.00	**Study 2: *Bacillus cereus* septicaemia from contaminated nutrition drips** William Newsholme, *Guys and St. Thomas's Hospital, UK*
14:00 – 14:25	**Study 3: *Stachybotrys sp*. – A date to remember** Stephen Wilson, *Sheffield Teaching Hospitals NHS FoundationTrust, UK*
14:25 – 14:45	**Tea and coffee**
14:45 – 15:10	**Study 4: Legionella in birthing pools** Julie Samuel, *Public Health England, UK*
15:10 – 15:35	**Study 5: An unusual haematology case** Dave Partridge, *Sheffield Teaching Hospitals NHS Foundation Trust, UK*
15:35 – 16:00	**Study 6: An unusual Intensive Care Unit case** Stephen Wilson, *Sheffield Teaching Hospitals NHS Foundation Trust, UK*
16:00	**Close**

MEMBERSHIP Benefits & Options

Benefits

The Society for Applied Microbiology is the voice of applied microbiology within the UK and was founded in 1931. Society Members play a leading role in shaping the future of applied microbiology, and enjoy many benefits, including:

- The opportunity to apply for one of our many grants or funds.
- Eligibility to win any of our awards or nominate a candidate for the S*f*AM Communications Award.
- Access to our five peer-reviewed journals: *Journal of Applied Microbiology* (JAM), *Letters in Applied Microbiology* (LAM), *Environmental Microbiology*, *Environmental Microbiology Reports* and *Microbial Biotechnology*.
- Free access to the entire collection of digitized back files for JAM and LAM dating back to 1938.
- A topical quarterly magazine, *Microbiologist*.
- Substantially reduced rates for attendance at S*f*AM meetings and conferences.
- Networking with worldwide professionals in over 80 countries
- Access to private Members' area of the S*f*AM website.
- Monthly email bulletins with the latest news from S*f*AM.
- Invitation to the annual *Environmental Microbiology* and *Journal of Applied Microbiology* lectures.
- Fostering cross disciplinary research.
- A 35% discount on the extensive Wiley-Blackwell collection of titles.

Detailed information about all these benefits and more can be found on the Society website at: **www.sfam.org.uk/membership**.

GRANTS & AWARDS

Many grants, awards and prizes are available to Members including the W H Pierce Memorial Prize and prizes for student oral presentations and posters at the Summer Conference. In addition to these substantial awards, the Society has funds to assist Members in their careers as microbiologists. These include the President's Fund, Conference Studentships, Sponsored Lecture Grants and the popular Students into Work Scheme.

Full details of all the Society's grants and awards, together with application forms, can be found on the website at **www.sfam.org.uk/grants**.

JOURNALS

The Society publishes two monthly journals: *Journal of Applied Microbiology* and *Letters in Applied Microbiology*. We also produce this quarterly colour magazine, *Microbiologist*, which contains features, topical news stories and full details of our meetings. The Society is also a partner with Wiley-Blackwell in the monthly journals: *Environmental Microbiology*, *Environmental Microbiology Reports* and *Microbial Biotechnology*. See more at **www.sfam.org.uk/journals**.

All Full and Student Members receive free access to the online versions of the Society's journals, and can also submit papers to our journals via an online submission service.

MEETINGS

We hold three annual meetings: the Winter Meeting is a one-day meeting with parallel sessions on topical subjects; the Spring Meeting is a one-day meeting tailored for personnel in clinical microbiology; and the Summer Conference is held every June/July and comprises a main symposium, a poster session, the AGM and a lively social programme. All Members are invited to our prestigious annual lectures held to commemorate the success of two of our journals: *Environmental Microbiology* and the *Journal of Applied Microbiology*. We also hold *ad hoc* meetings on topical subjects and enter into joint ventures with other organizations on topics of mutual interest.

WEBSITE

www.sfam.org.uk is the best source of detailed information on the Society and its many activities. It has a fully interactive Members-only area (**www.sfam.org.uk/membersonly**) where you can find archive issues of *Microbiologist*, exclusive S*f*AM documentation and much more.

Membership OPTIONS

Full Ordinary gives access to our many grants and awards, online access to the *Journal of Applied Microbiology*, *Letters in Applied Microbiology*, *Environmental Microbiology*, *Environmental Microbiology Reports* and *Microbial Biotechnology*, copies of *Microbiologist*, preferential registration rates at Society meetings, and access to the Members-only area of the website.

Full Student confers the same benefits as Full Membership at a specially reduced rate for full-time students not in receipt of a taxable salary.

Associate is only open to those with an interest in applied microbiology without it being a prime aspect of their job. For example, school teachers and those taking a career break, on maternity leave, or working temporarily in other areas. It does not provide access to any journals or Society grants and awards.

Honorary membership of the Society is by election only and this honour is conferred on persons of distinction in the field of applied microbiology. Honorary Members have access to our online journals.

Retired is available to Full Members once they have retired from their employment. Retired Members are entitled to all the benefits of Full Membership except grants and access to the Society's journals.

eAffiliate: this category of membership is open to microbiologists residing in Band I developing countries and is free of charge. It is an online only membership and provides access to the eAffiliate bursary only.

eStudent: this category of membership is open to undergraduate students only. It is an online only membership and is free of charge. This category of membership does not provide access to the Society's grants or journals.

Corporate is open to all companies with an interest in microbiology. Corporate Members benefits include:

- Quarter page advertisement in each issue of *Microbiologist* (which can be upgraded to a larger size at discounted rates).
- The opportunity to publish press releases, company news, etc., in each issue of *Microbiologist*.
- FREE banner advert on the Society website with a direct link to your company site.
- Up to three Members of company staff attending Society meetings at Members' rate (this means a 50% discount on non-Member registration rate).

Join us!

You can apply for membership online (**www.sfam.org.uk/join**) or offline. To apply offline, please contact the Membership & Finance Co-ordinator, Julie Wright on **+44 (0)1234 326846**, or email **julie@sfam.org.uk**.

Membership CHANGES

We would like to warmly **welcome** the following new Members to the Society.

BELGIUM
A. Soro-Yao

CANADA
A. P. Kaur

DENMARK
N. Frigaard

IRAN
B. Hosseini
M. Moradi

IRELAND
J. Gray
R. Johnston
R. Lewis

IVORY COAST
A. C. Kadjo

LIBERIA
G. Gwesa

MOROCCO
Y. Kasmi

NIGERIA
M. E. Abosede
S. Adeyemo
S. A. Akinola
E. Akiomon
C. J. Aneke
C. O. Anyiador
T. Bamidele
R. Danesi
O. Egbenoma
J. Ehianeta
C. C. Ekwealor
C. B. Ekwuabu
E. Ero
C. L. Ezeafulukwe
C. C. Ezekoye
M. O. Falowo
C. Nnamchi
P. Odidison
P. H. Ogbonna
A. A. Oguejiofor
J. Ohenhen
C. U. Oka
C. Okarfor
I. Okhuosi
O. Okoh
E. T. Okoria
N. Okosun
O. O. Olaleye
P. Ome Anayochukwu
B. O. Omojowo
N. J. Onoyima
N. O. Orakwelu
J. Ozenabor
A. Seriki
A. A. Udah

SOUTH KOREA
E. Gwak
J. Ha
J. Lee
J. Seo
J. Seo

SWITZERLAND
E. Margas

UAE
N. Muhwati

UK
L. M. Ackerley
P. Adamowicz
T. Al Keilani
A. Ali
M. Aljubouri
S. Al-Osaighari
A. Altaf
T. M. Ameginsso
O. Aniejurengho
J. Auty
Z. Aziz
K. Bairstow
L. Barr
J. Bartlett
A. J. Baumgartner
J. A. Beddow
R. Berwick
A. Bhunnoo
S. Bishop
G. Bolton
L. Bouley
Z. Bowles
J. Box
K. Browne
R. Bruce
T. Butler
F. M. A. Charlton
M. Chaudhary
H. Cheung
Z. Chiverton
V. Chodyreva
D. Da Silva
S. Daly
K. Davies
K. S. Dixon
H. Douglas
M. Dowson
N. Drescher
S. J. Duddy
E. A. Duncan
A. L. A. N. Dutka
D. Duxbury
J. E. Ebdon
C. Edwards
L. Edwards
D. Ellwood
M. Evans
I. L. Ezeajughi
P. Figg
A. Foulkes
S. Fox
J. A. Freeman
J. French
O. George
N. George
K. Gilmour
A. Grayson
D. Gunes
R. E. Harris
M. Harris
S. Higham
H. Hodges
S. Holland
C. Hon
S. Hood
L. A. Jaafari
T. A. S. Jilani
R. Karim
R. Kelshaw
S. M. Korcz
A. Kumar
M. P. Kuruppu Appuhamilage
D. Lancaster
J. Lawanson
L. A. Lawton
B. Lehri
M. K. Y. Lim
J. Lindsay
C. L. Loftus
H. Marbach
R. Martin Hidalgo
H. M. Masuge
R. McBride
D. McGurk
P. Meighan
K. Minas
N. Minto
S. Mohamud
J. Moody
C. Moon
N. Moore
A. Moorhouse
L. Mulholland
D. Murphy
L. Myatt
A. Namjoynik
S. Noori
A. Odufuwa
M. Q. Ooi
K. Oshafi
T. Oyebanji
K. M. Parfitt
J. Patel
S. Patel
D. Patrick
C. Patton
C. Pennick
J. Phetcharaburanin
H. Pickford
L. Plant
K. Purves
J. Quinn
M. J. Rahim
S. S. Rajpoot
E. Ramzan
K. Ratnayake
J. Redfern
S. Regan
P. U. Richard
M. Ross
J. Santos
L. Scott
J. Scott
F. B. Shah
P. Sharry-Khan
S. Shepherd
I. N. Sierra Garcia
L. Skyes
R. Smith
E. Sozzi
J. Sparshott
A. M. Thomas
H. F. Thompson
E. Torbet
L. Townsend
I. Vitkauskatie
R. Wardman
R. Wesgate
L. J. Wharton
H. Wiffen
J. Williamson
K. Wray
K. X. Zhou

USA
P. Borrusso
T. Chadha
P. Cook
S. H. Han
K. Hollen
N. Jarvis
B. Jayasundera
W. M. Leong
B. Mazon Villegas
D. Smith
K. Thayer
A. Vasan
S. Wu

ZIMBABWE
F. Pswarayi

Introduction to your NEW PECS COMMITTEE

During the Annual General Meeting of PECS during the Summer Conference in Brighton, in July, several key members of the PECS Committee stepped down and were replaced by some new and some familiar faces. Before introducing your new Committee we would like to take this opportunity to thank all of those who have served on the Committee and have moved on to pastures new, these include the former Chair Emmanuel Adukwu, Secretary Amara Anyogu and the Publication Officer Jenni Drever-Heaps. The Committee wish to thank you for your long service and wish you all the best with your future endeavours and hope to see you at future S*f*AM meetings. Now to introduce the new Committee:

CHAIRPERSON
Agnieszka Piotrowska

Agnieszka has moved from a role in Communications to Chair the Committee and keep the rest of us in line. Agnieszka is currently working on her PhD where her research focuses on genes involved in metal homeostasis, how this contributes to *Salmonella* pathogenicity, intracellular survival and applications of *Salmonella* promoters for medical biotechnology. She is also involved in various STEM activities as an STEM Ambassador promoting science among young people. She is also a part of Science Grrl Edinburgh, an organization supporting women in science.

SECRETARY
Sabrina Roberts

Sabrina's main role will be taking minutes at Committee meetings and being heavily involved in the organization of meetings. Sabrina is in the process of writing up her PhD at Kingston University where she is studying the effect of Correia Repeat Enclosed Elements in the regulation of gene expression in *Neisseria* spp. Through S*f*AM Sabrina has also been involved with public engagement activities such as the Cheltenham Science Festival.

PUBLICATIONS OFFICER
Ali Ryan

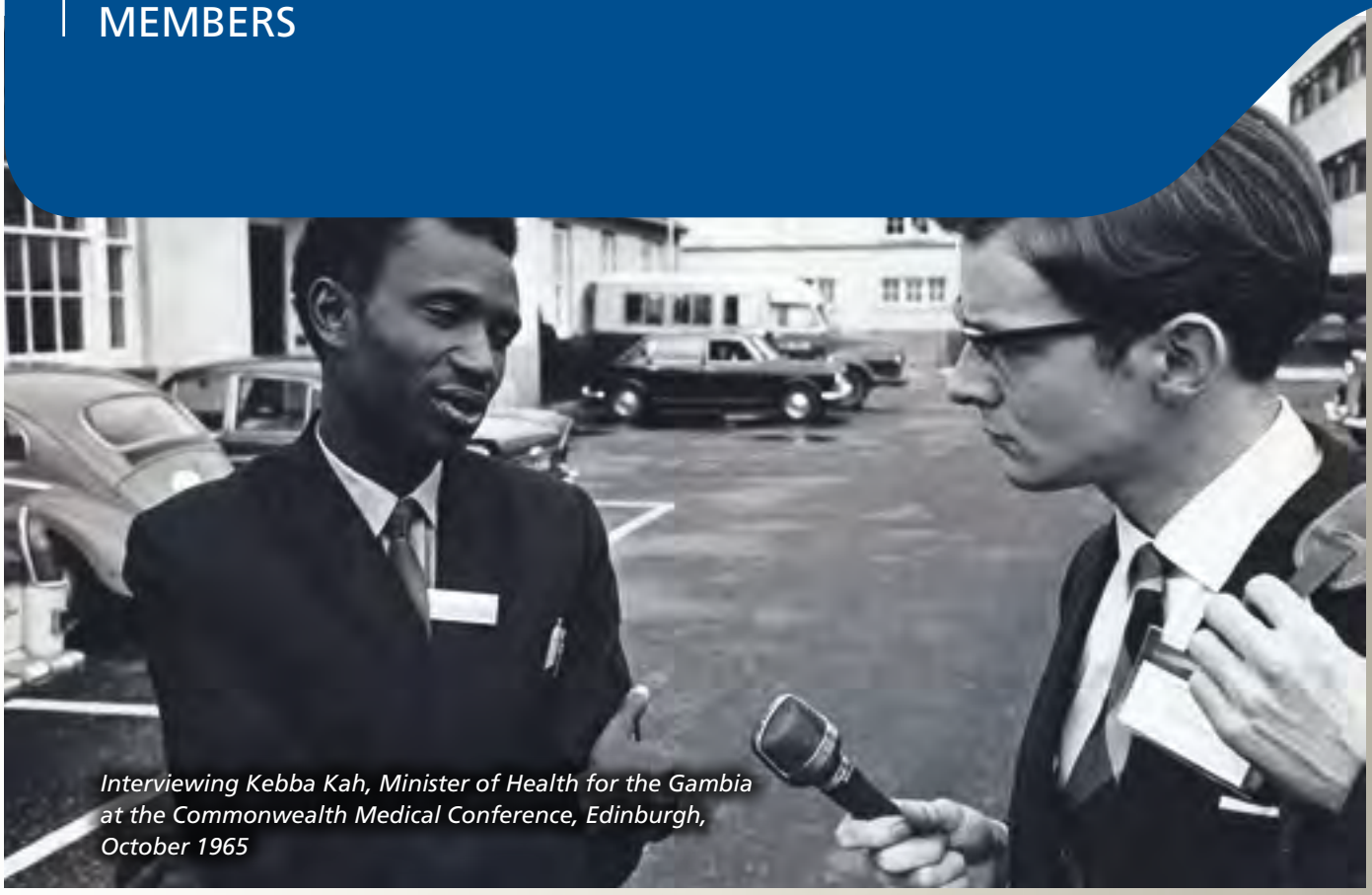
My main role as Publications Officer will be to prepare this column for the *Microbiologist*. I completed my bachelor's degree and PhD at Imperial College, during which time I worked for GSK in their drug discovery arm. After my PhD I moved to Oxford University for postdoctoral work. I am now a group leader at Kingston University where my main research interests are in the identification and exploitation of novel antimicrobial targets.

COMMUNICATIONS OFFICER
Stewart Barker

Stewart will be in charge of the PECS section of the S*f*AM email bulletin and also the PECS email inbox. He recently obtained a first-class degree in Biology from Sheffield Hallam University and has just started his PhD studying peptidoglycan cleavage enzymes in Gram-positive bacteria.

Alongside these changes we also welcome onto the Committee as Ordinary Members; Nasim Farahmand, Nieky van Veggel, Zara Gerrard, Jana Hiltner and Aled Roberts. Moreover, we continue to work with Ellen Evans and Christiana Adesanwo on the events team. So that is your new-look PECS Committee, we hope to meet you all over the next few years at conferences, and please feel free to come up and talk to us about the events we are holding.

Ali Ryan



Interviewing Kebba Kah, Minister of Health for the Gambia at the Commonwealth Medical Conference, Edinburgh, October 1965

The secret to success: Know your audience

A newly minted BSc from King's College, Durham, in 1959 seemed unlikely to lead to my becoming the Editor of *New Scientist* only a decade later; influencing Government regulation of antibiotics; writing 10 books; running science communication courses for the Wellcome Trust, the Royal Society, Cancer Research UK and Oxford University; and meeting people such as the developer of the poliomyelitis vaccine, Albert Sabin, smallpox eradication supremo, Donald Henderson, and penicillin pioneers Ernst Chain and Norman Heatley.

But so it proved. Although the immediate years were conventional enough (a PhD thesis on ornithine carbamoyl transferase synthesis in yeast, followed by a postdoctoral fellowship at what had become the University of Newcastle upon Tyne), my major interest was already in writing about science rather than doing it. In 1965, I joined the newly launched *World Medicine* as assistant and later deputy Editor. By a fortuitous sequence of events shortly afterwards I then found myself appointed deputy Editor of *New Scientist* and (in 1969) Editor.

One link between my time in Newcastle and 10 years running *New Scientist* was publishing an article by a former flatmate, Fred Hayes. Working at the University of Aston, he had helped to reveal the biochemistry of how *Agaricus campestris* mycelium in the soil pops up fruiting bodies – mushrooms. Although Fred had written several papers on this phenomenon, it was the *New Scientist* article (and stunning cover photograph) that landed him a contract with the Food and Agriculture Organization of the United Nations (FAO), then promoting mushroom cultivation in Third World countries.

Other articles I was especially pleased to publish included one that first brought Jim Lovelock's idea of Gaia to public attention; one describing an investigation of Uri Geller, at a time when *Nature* had (surprisingly) accepted a paper on his "paranormal" metal bending claims; and another based on our bugging of the House of Commons. It was also rewarding to launch a long-running, influential column on science in parliament by Labour MP Tam Dalyell.

In the late 1960s I got to know E. S. Anderson who, as director of the Enteric Reference Laboratory, Colindale, was charting a disquieting rise in antibiotic resistance in salmonellae, associated with the inclusion of antimicrobials in feedstuffs to promote the growth of farm animals. By writing articles and editorials in the *New Scientist*, I was able to focus public and political attention on these dangers, which led to the banning of

penicillins and tetracyclines as growth promoters. Robert Bud tells the whole story in *Penicillin, Triumph and Tragedy* (OUP, 2007).

When I resigned in 1979, several friends were puzzled. The magazine was riding high – thanks to an unusually talented editorial team, we had nearly doubled the circulation. Paradoxically, however, success had greatly increased my management load when what I really wanted was to be an Editor and writer. So I took the risk of giving up a full-time job to go freelance. The core of my work over the ensuing years was serving as European Editor for various American periodicals – the science and science fiction magazine *Omni*, followed by the magazine of the American Association for the Advancement of Science and then *Nature Biotechnology*. I also became Editor of *Medical Science Research* and a columnist for *The Spectator, Lancet Infectious Diseases*, the *British Medical Journal* and the Italian periodical *Biotec*, as well as portraying a "Microbe of the Month" for *The Independent*.

For three years I was European Editor of *The Scientist*, combined with a much broader role with its publisher, the Philadelphia-based Institute for Scientific Information, founded by Eugene Garfield around the new craft of citation analysis. After creating the *Science Citation Index* as a bibliographical retrieval tool, ISI was fostering the idea of using citation patterns to compare the impact in the literature of different individuals, institutes and countries.

An event that linked my citation work with media liaison for conferences was the 14th International Congress of Microbiology in Manchester in September 1986. There we held a seminar with authors of "citation classics" – papers unusually heavily cited in the literature. Kath Adams (now my partner) and I ran a press room at the meeting, before which we prepared and distributed press releases on papers likely to appeal to journalists. In addition to successive European Congresses of Biotechnology, two other events of this sort were the First International Conference on the Release of Genetically Engineered Microorganisms in Cardiff in April 1988 and the 17th International Congress of Genetics in Birmingham in August 1993. For both of these events, I wrote a booklet highlighting key issues.

I'm often asked what I have learned from writing books – which range from *What is Science For?* (Collins, 1973) and *Invisible Allies* (Temple Smith, 1976) to *Beyond the Magic Bullet* (Allen & Unwin, 1978) and *Animalcules – The Activities, Impacts and Investigators of Microbes* (ASM Press, 2009). My overriding conclusion is the huge significance of a title – as shown by the fact that the German translation of a book originally called *Power Unseen* (W. H. Freeman, 1994) sold many more copies than the English edition. The only difference was that the German publisher gave it a title based on just one chapter – the story of how John F. Kennedy's presence in the USA could be traced back to the Irish potato famine, caused by *Phytophthora infestans*, which spawned a mass exodus from Ireland in the mid-19th century. Two of the emigrant families were the Fitzgeralds from Kerry and the Kennedys from Wexford County.

And my main lesson from work in communication generally? The answer is the paramount importance of being familiar with your readers' or listeners' level of knowledge. If you work on *Plasmodium* antigens and you are addressing other *Plasmodium* immunologists, you do not need advice. You can simply make grunting noises and you will be understood. But the vast majority of audiences are more heterogeneous, often surprisingly so. Consider, for example, how much a clinical virologist knows about the current terminology, concepts, controversies and techniques in another area of microbiology such as nitrogen fixation – and *vice versa*. Being thoroughly aware of the composition of your audience is 90% of the secret of successful communication.

Showing the New Scientist cover to the Duke of Edinburgh at the magazine's offices in King's Reach Tower, London, February 1978

Bernard Dixon

STUDENTS into WORK Grant report

ANTIMICROBIAL ACTIVITY of Antiseptic Wound cleansers used in Wound Care

Studying at a German university in the field of biology, I always wanted to work at an international level to get as much expertise and skills as possible. Professor Valerie Edwards-Jones from Manchester Metropolitan University offered me a placement in her laboratory with my own project in clinical microbiology. With helpful funding from the Society for Applied Microbiology, I was able to spend over 10 weeks in the UK.

The aim of my project was to determine the effectiveness of several topical antiseptics against biofilm-forming microorganisms on injuries like open wounds. This study was to create data for which antiseptic to use against a range of organisms. Seven commercially available antiseptics (polyhexamethylene biguanide (PHMB); chlorhexadine digluconate solution 20%; Prontosan®; Silver-nitrate; Povidone iodine 10%; Octenilin; Salvox 2000) were tested on four omnipresent organisms (MRSA; *E. coli, Enterococcus hirae* and *Pseudomonas aeruginosa*), which are mainly found on contaminated wounds.

This project could help to choose, in a hospital environment, the right antiseptic to reduce contamination in a wound. Healthcare associated infections (HAIs) resulting from infective agents such as MRSA, vancomycin-resistant enterococci (VRE), *Acinetobacter baumanii* and other opportunist pathogens are becoming more common and increasingly difficult to treat, especially MRSA which spreads quickly in the population and poses a tremendous threat for surgical patients (Agostinho *et al*., 2011). Collectively, it is estimated that these infections, on average, affect 1 in every 10 (10%) admissions to hospital, have a knock-on effect on bed efficiency and cost the NHS around £20m to treat annually. Most importantly, there are increasing numbers of fatalities with over 5,000 deaths reported in the UK per annum (National Audit Office, 2000). Antibiotic-resistant bacterial strains are often isolated from colonized chronic wounds and create a potential risk for fellow patients within the healthcare environment. Most laboratories routinely report these pathogens and their associated antibiotic susceptibility. However, most chronic wounds are not treated with antibiotics but with antiseptics following wound debridement (Lipsky *et al*., 2009). Many wound dressings contain antiseptics to help with the reduction of wound bioburden and to reduce bacterial spread. These antiseptics are PHMB, silver (salts or metallic), chlorhexidine, iodine, honey (manuka) and some burns dressings contain tea-tree oil (Lipsky *et al*., 2009). Many clinicians do not like to use antiseptics for any length of time because of potential toxicity and prolonged healing times. Dressing manufacturers advocate that the antiseptics are used for two weeks in the first instance and should only be continued if the wound looks improved or bioburden is reduced (Atiyeh, 2009).

For testing the effectiveness of antiseptics, the MIC and MBC were tested against the planktonic bacteria. A microtitre plate assay was used to determine the MIC/MBC.

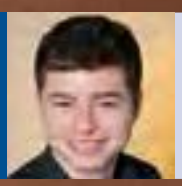
Following these results, the killing kinetics were determined using killing studies. Finally, the ability to inhibit biofilm formation with those antiseptics was tested using a crystal violet assay. Altogether, this project gives an overview about the effectiveness of antiseptics under perfect conditions. The right choice of an antiseptic will help to relieve an injured patient faster from microbial contamination.

This project could help to choose, in a hospital environment, **the right antiseptic to reduce contamination** in a wound

For me the hardest task was to apply all the techniques and follow instructions in another language. However, working on my own was also a whole new experience. While at university someone is always standing next to you and watching every move you take, during this project I had to plan, organize and put everything I had learnt into practice on my own. Thankfully, Professor Valerie Edwards-Jones and the staff of the laboratory were always available providing me with information and skills to succeed in my task.

During my time I have developed a lot of different skills, from good aseptic techniques, applying microbiology test methods, a technical understanding of how antiseptics affect microorganisms and, the most important skill, keeping good records in my lab book and producing a laboratory report out of it.

I guess you will smile, when I say that I totally underestimated the complexity of microbiology at the beginning of my placement. I now know that small changes in test execution can change the outcome of your results. Learning the importance of unimpeachable reproducibility and the use of replicates in a research environment was an abiding lesson for my future career. Working in this field as a microbiologist was an incredible experience, where I got an insight of their work, met new friends along the way, improved my language skills and even took part as a participant in a small trial, carried out by another student. I am so grateful for getting this opportunity. I would like to say thank you to the Society for Applied Microbiology for funding me and to Professor Valerie Edwards-Jones and her team for taking me on this placement. Thank you!



Michail Ostrovsky

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Corporate NEWS

The latest news, view and microbiological developments from our Corporate Members

New agency, new name

A new Defra agency, which formally launched on 1 October 2014, will be called the Animal and Plant Health Agency.

It will consist of the Inspectorates from FERA (Bee Inspectorate, Plant Health and Seeds Inspectorate, Plant Variety and Seeds Group and the GM Inspectorate) and AHVLA. The agency will be responsible for animal health and welfare and the regulatory and enforcement aspects of plant health and bee health.

In line with this change the commercial services of the new agency has been rebranded APHA Scientific (formally AHVLA Scientific). The expanded activities of the new agency broaden the commercial services of APHA Scientific to encompass wildlife and plant health alongside its extensive range of veterinary, scientific and other services.

Further Information

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New bio-decontamination system complements Cherwell's sterilization process validation products

With the importance of efficient, reliable decontamination of cleanrooms and other critical areas within the healthcare, pharmaceutical and biotech industries is undeniable. Having signed a UK distribution agreement with Mar Cor Purification, Cherwell Laboratories can now offer dry fog technology and cold sterilant products to provide the ideal solution.

Cherwell Laboratories have built a reputation for providing high-quality products to meet the process validation and environmental monitoring requirements of the pharmaceutical and healthcare industries. The addition of Mar Cor Purification's decontamination products complements the existing product portfolio enabling Cherwell to offer a comprehensive solution to customers. The new decontamination system, suitable for use in pharmaceutical cleanrooms and other critical areas, incorporates the highly effective Minncare® Dry Fog and Mini Dry Fog systems plus Minncare and Actril Cold Sterilants.

Alongside the new decontamination products, Cherwell offer biological indicators for the validation of sterilisation processes, Redipor® prepared microbiological media and SAS microbial air samplers. The range has been developed over time to meet the changing regulations within the pharmaceutical and related industries whilst maintaining Cherwell's commitment to offering the highest quality products, expert advice and customer service levels.

Further Information

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Still using spread or pour plates to achieve your microbial count?

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WASP offers you:

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A single keystroke loads the sample, inoculates a plate and cleans the dispensing tip to optimise sample throughput speed. With WASP you can prepare 8 x 50µl plates in 2 minutes 35 seconds and dispense volumes from 10µl to 400µl, providing immense flexibility and repeatability.

For laboratories using 9cm plates from different manufacturers, there is now the option to specify a self-centering, adjustable turntable that requires no manual adjustment.

Exclusive to DWS (for UK customers) is the 'Quality Counts Scheme' should you need to provide external quality assessments. This is free for the first year with the purchase of a WASP.

WASPs are being used by customers to test for safe levels of bacteria in a variety of food stuffs such as milk, dairy, fish, poultry and frozen food. It is also used in pharmaceuticals, cosmetics, the water industry and for mouth and skin bacteria.

Further Information

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Convenience and ISO formulation are key to Lab M's µPrep™ Half Fraser Broth ISO (+FAC) success

21 October 2014; Heywood, UK: Lab M is seeing demand grow quickly for the company's recently launched µPrep™ Half Fraser Broth ISO (+FAC), a complete primary enrichment broth designed for use in the isolation of *Listeria* spp. from foodstuffs. Media in Lab M's µPrep™ range are supplied ready-to-reconstitute in 20 litre bags. They are designed primarily for high throughput laboratories where speed, convenience, reliability and cost-effectiveness are high priorities.

"Since we launched µPrep™ Half Fraser Broth ISO (+FAC) in July 2014, customers have been very clear that simple reconstitution with no mess and no autoclaving is a

significant factor in their choice of media format. However, the fact that the Lab M medium is based on the formulation of ISO 11290, and meets the performance requirements of ISO/TS 11133, is highly influential in their final choice of product," said Wendy Martindale, Director of Sales and Marketing for Lab M.

Reconstitution simply requires attaching a standard laboratory deionised or reverse osmosis water supply, via the Lab M filter accessory, to the bag. The medium reconstitutes rapidly, requires no additional sterilisation or supplementation and is ready to dispense and use in minutes.

To find out how µPrep™ Half Fraser Broth ISO (+FAC) can help streamline your laboratory's workflow visit **http://bit.ly/LabMHFB**.

Further Information

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The Mast **Uri**® System is an innovative, rapid and streamlined, semi-automated laboratory solution for the microbiological analysis of urine samples, to aid the diagnosis of urinary tract infections (UTI). In comparison to traditional bacterial culture based methodologies, the Mast **Uri**® System offers higher throughputs, simplified processing and rapid turnaround times, while significantly reducing costs and waste. As part of the Mast **Uri**® System range, customers can now purchase:

- Mast **Uri**® Plus - automated plate reader and sample analyser
- Mast **Uri**® Plates - 96-well plate format pre-poured media plates for bacterial identification and antibiotic susceptibility testing (AST)
- Mast **Uri**® Well - dispensing aid with 96 LED template for sample transfer
- Mast **Uri**® Dot - multiple sample inoculator

Mast have been focusing on developing new products to combat the ever-growing issue of antibiotic resistance, and as such, can now offer the Mast **Uri**®*plate*-CRE for the detection of carbapenemase-producing-Enterobacteriaceae, which can be easily implemented into any Mast **Uri**® System testing schedule.

For details on these, or any other products within the Mast Portfolio, please contact Mast on sales@mastgrp.com.

Further information

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Microbiologics Introduces New Line of Water QC Kits, EZ-Hydro Shot™

TMicrobiologics, Inc., a leading global producer of quality control microorganisms, announces EZ-Hydro Shot™, a product designed for water testing. Ready-to-use EZ-Hydro Shot™ organisms have been validated for membrane filtration and enzyme substrate methods and can be used for a variety of other test methods as well.

Microbiologics® EZ-Hydro Shot™ comes in the form of a quantitative, lyophilized organism pellet; the strains included in EZ-Hydro Shot™ kits are indicator organisms – organisms that readily indicate water contamination. The product has been validated for use with multiple tests including Standard Methods for Examination of Water and Wastewater, and EPA test methods.

EZ-Hydro Shot™ is designed for convenience. The organism pellets are packaged in individual glass vials; no pre-incubation steps are required to prepare EZ-Hydro Shot™ and the pellets instantly dissolve, saving laboratories considerable time and labor. This product delivers a low-level concentration of 20-100 CFU per pellet. EZ-Hydro Shot™ is conveniently packaged in a kit containing multiple strains carefully selected for particular test methods, and it can also be purchased as a set of one specific strain allowing customers more flexibility.

Further Information

Visit: www.microbiologics.com
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Virus specimens from near or far?

One of the key challenges for virologists is obtaining a good specimen and transporting to the laboratory. With increasing specialisation, virus specimens may have to travel large distances, even between continents for novel diseases or emergencies, as with the recent Ebola outbreak. Most testing is now done using molecular techniques, but there are still circumstances when it is desirable to keep the virus alive for culture, characterisation, and for the development of new tests.

Sigma Virocult® from MWE covers all of these requirements. Based on a medium which has been proven for over 35 years to maintain viruses for several days in a viable state, even at ambient temperatures, it is also fully compatible with the latest molecular techniques.

Sigma Virocult® is suitable for respiratory, enteric, oral, skin, and genitourinary viruses, whether RNA or DNA, and, whether affecting humans or animals, or both.

Sigma Virocult® can be supplied with one or two swabs, with standard or min-tip buds (cellular foam). The liquid medium format is particularly suitable for aliquotting and testing on different platforms.

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New NCIMB video demonstrates ampoule opening

NCIMB manages a unique collection of more than 8000 reference cultures, most of which are supplied freeze dried in sealed glass ampoules.

The ampoules contain a strip of filter paper impregnated with freeze dried culture. Once the ampoule has been opened, the strip can be dropped directly into or onto the appropriate medium.

While a range of our most commonly used QC cultures are also available in easy-to-use screw top vials and the MicroSnap™ format, for the majority of reference cultures in our collection, glass ampoules are still the most appropriate solution.

Feedback from our clients has indicated that some would welcome training on how to use the ampoules, and in response we have produced a video that clearly demonstrates the correct procedure for breaking the glass and use of the strips. Although the requirement to break glass ampoules may make them seem a little more daunting than other formats, they really are quite straightforward to use, and we hope that our video illustrates that.

The video can be found on our website at www.ncimb.com along with a searchable catalogue of our reference cultures and an extensive collection of media recipes.

For more information or to place an order contact enquiries@ncimb.com or telephone +44 (0)1224 711100

Further Information

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EliGene® Kits and RealTime PCR instruments now available from TCS Biosciences Ltd

We are pleased to announce we are now distributors for Elisabeth Pharmacon. Elisabeth Pharmacon became the first Czech Republic company to produce DNA diagnostics under ISO 13485 certification in 2008. Since 2012 the company now develops and manufactures laboratory instruments.

EliGene® kits are divided according to detection chemistry into three basic ranges, namely UNI, RT and LC.

Advantages of EliGene® isolation kits

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- Special composition of the reagents and columns guarantees high yields and minimises risk of inhibition during PCR.
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- New fully automatic isolation of DNA/RNA from all kinds of clinical samples by ZEPHYRUS® Magneto instrument.

Advantages of EliGene® detection kits

- The use of the internal control allows to monitoring of the extraction procedure and checking for possible PCR inhibition.
- Kits are supplied with positive controls allowing quality control of the analysis.
- Simultaneous amplification (multiplex) of DNA/RNA from pathogen and internal control in one PCR tube.
- The use of Hot-Start technology minimizes the risk of non-specific reactions and provides ultimate sensitivity 1-10 copies of nucleic acid/reaction.
- The usage of ready-to-use Mastermixes containing all reaction components for easier reaction setup and handling.
- The usage of EliGene® UNI kits enables complete detection in 50 minutes.
- Kits are validated on LightCycler® 1.2, 2.0, Nano and 480, ABI® 7300, 7500 and 7500FAST, RotorGene-Q (RotorGene 6000). Compatibility of the kits with broad range of instruments – RotorGene®, SmartCycler®, Mx3000P and 3005P® QPCR systems of iQ5®, CFX96® and other cyclers.

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