PHARMACOLOGY MATTERS

BPS BRITISH PHARMACOLOGICAL SOCIETY
Today's science, tomorrow's medicines

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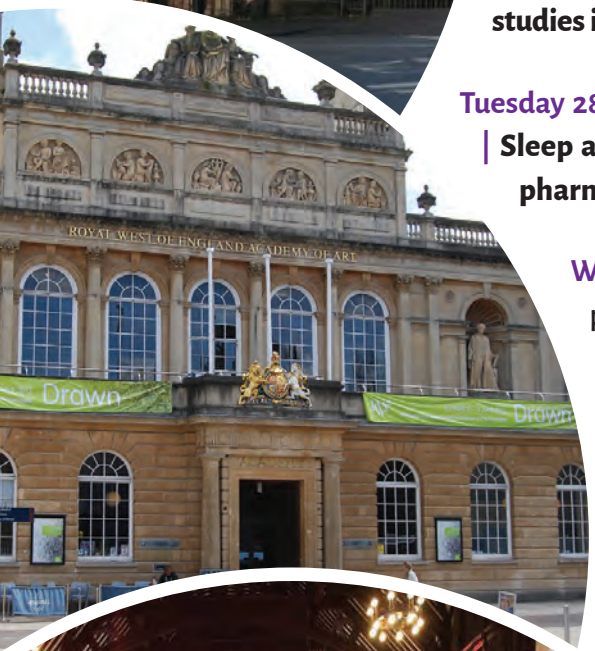
Framing our impact

REF2014 | Speakezee | Returnerships | Vote Science

BAP

British Association for Psychopharmacology

SUMMER MEETING 2015



School of Chemistry, University of Bristol, UK
Sunday 26th to Wednesday 29th July 2015

Featuring a range of non-clinical and clinical presentations across of range of neuropsychiatric conditions

Pre-Clinical Workshop: A new 3Rs challenge for animal research in psychiatry: reproducibility, relevance, reverse translatability

9 invited symposia covering cutting-edge clinical and non-clinical psychopharmacology:

Monday 27th July – **Use and abuse of novel psychoactive substances** | Bipolar disorder: looking to the future | **Of models and men: translational imaging studies in advancing mechanistic understanding of neuropsychiatric diseases**

Tuesday 28th July – Where now for glutamatergic strategies for schizophrenia? | **Sleep and drugs in the 21st century** | **The Electronic cigarette: from basic pharmacology to smoking harm reduction and cessation**

Wednesday 29th July – Advances in compulsivity: a trans-diagnostic perspective | **The role of synaptic proteins in schizophrenia and related neurodevelopmental disorders** | **Non-invasive neurostimulation**

Welcome Drinks Reception at the Royal West of England Academy of Art

Conference Dinner at Bristol Grammar School including presentation of the 2015 Prizes and Awards

For full details of the meeting, including abstract submission and registration, go to

www.bap.org.uk/summermeeting2015

Abstract submission deadline: **27 March**

Editorial

This Spring issue of *Pharmacology Matters* has a strong theme of 'Impact'–be it the impact that the HEFCE-driven assessment exercise has had on UK higher education institutions, or the impact that pharmaceutical companies have with respect to drug development. A constant thread throughout the issue is the important impact that the scientific community has on the health and welfare of our society.

Following Jono's update on the Society's objectives for the year ahead, Bruce Hood (p5) discusses the important emphasis that the Research Excellence Framework (REF) 2014 placed on 'impact', and introduces us to speakezee.org, a new way to speak to more general audiences. This is followed by Barbara McDermott's (p7) insight (having served on one of the assessment sub-panels) into how REF2014 assessed 'impact' on the basis of case studies, all of which are now published on the REF2014 website.

Laura-Nadine Schuhmacher (p8) in her interview with Sara Pritchard, gives us an interesting insight into what a career in the pharmaceutical industry is like and describes the differences in research between academia and industry.

Cat Ball (p10) reassures readers that the tide is turning for those who have taken career breaks, no matter what the reason (e.g. to focus on caring responsibilities, illness, unemployment or a change of career). She discusses the impact that new strategies, e.g. 'returnships', are having on people returning to work, although still more needs to be done.

Congratulations go to Christine Edmead, Bath University, for winning the inaugural Student Choice Award for Excellence in Pharmacology Teaching. You can read all about it in the Young Pharmacologists' update (p11). A report on the President's Lecture, this year given by Patrick Vallance, can be found on p12 followed by Mark Downs' article (p13) highlighting the impact that the bioscience community has–encouraging us to engage with the Society of Biology's policy work.

Kathryn Garner (p14) gives us a glimpse into how her work in cell signalling has been coupled with her love of art. If you too have an interesting hobby, please do get in touch, as we would love know more about our talented members!

We have a fascinating article on the impact that transient receptor potential (TRP) channels have in first sensing, and then eliciting, a successful vascular protective response to local noxious cold exposure. Finally, there is a pair of articles continuing the theme of antimicrobial resistance from December's issue. The first focuses on the urgent need for novel antimicrobial drugs (AMDs) in veterinary medicine, and the second discusses the impact that pharmacokinetic/pharmacodynamic (PK/PD) integration and modelling of AMDs will have on optimising bacteriological cure and minimising the emergence resistance.

Enjoy!

Felicity

Felicity NE Gavins
Editor-in-Chief
Pharmacology Matters

Contents

Cover credit: Kathryn Garner,
Purple Cell Drawing (1999) Ink and emulsion paint on paper

Your BPS

Jono Brüün
BPS Chief Executive

With 2015 now in full swing, staff and officers at the Society are engaged with delivering our objectives for the year ahead. Annual objectives are agreed every year by Council, and map onto the 5-year strategic aims that were agreed back in 2012. These objectives give the Society a purpose and an agreed set of indicators against which we may be held accountable to our members, so they are an important part by our planning and delivery cycle.

In 2015, we have agreed to undertake a range of activities across all of our departments. A full version of these objectives can be found at bit.ly/Objectives2015 but highlights are as follows:

Membership

- Define a grants and awards strategy that matches the needs of the Society's membership and supports pharmacology in the modern world
- Develop and agree a strategy to recruit more new members to the Society

Education & Outreach

- Update the Society's core pharmacology curriculum with reference to broader bioscience teaching practices
- Evaluate and implement options to produce a range of new learning opportunities for members and non-members, including through subject-specific e-learning

Scientific Meetings

- Oversee the successful establishment of Affinity Groups and their input into the Society's Scientific Programme

Publications

- Take steps to ensure business continuity and development across a range of areas, including through appointments to key positions, and the negotiation of a new publishing contract

Policy & Public Engagement

- Increase the Society's visibility and impact, including through enhanced Outreach, Media and Public Engagement activities
- Redevelop and launch a new website in line with the outcomes of the Society's Branding Review

Clinical Pharmacology

- Support the 2014 report *Recognising the value of Clinical Pharmacology and Therapeutics* by ensuring its recommendations are taken forward appropriately

Finance & Commercial

- Deliver new business development opportunities in support of the goal to diversify the Society's sources of revenue.

So, we have a busy year ahead with plenty of new initiatives in support of our goal to advance pharmacology. In particular, 2015 should see a lot of activity from our education department, and in the development of innovative products that we hope will provide new revenues for the Society, and services for its members and others in the near future.

To help deliver that programme of work, I am delighted to welcome two new members of staff to the team.

Dr Anna Zecharia joined us in January as Head of Education and Training, and will be working closely with Rebecca Tibbs, our Education and Outreach Manager to drive the review and redevelopment of our core curriculum, Diploma, and *in vivo* funding work, along with ongoing projects such as the Prescribing Safety Assessment. Anna gained a BSc in Pharmacology from Guy's, King's and St Thomas' School of Biomedical Science. She completed her PhD and postdoctoral training in cellular and *in vivo* neuroscience at Imperial College London where she used genetic mouse models to study how natural sleep pathways interact with sedatives and general anaesthetics. Anna is also the co-founder of ScienceGrrl, an organisation which supports and showcases women and girls in science.

Also joining the team in the newly created role of Head of Innovation and Product Development is Dr David James. David was formerly Executive Director, Strategic Innovation, at the Royal Society of Chemistry (RSC), leading the organisation's business development planning for new products and services. David delivered customer, market and competitor analysis for RSC, and identified business acquisition or partnership targets for that organisation. He was also responsible for online platform development for the delivery of RSC content as well as having responsibility for international strategy. David has a PhD in Biochemistry from Birmingham University and an MBA from the Open University, and will be joining the Society on a 12-month contract this month.

After seven years at the Society, Karen Schlaegel, Head of Meetings & Events, has decided to move on to Pastures new, and will leave us at the end of June. Karen's time at the Society has been a real success, particularly in overseeing the development of the Society's scientific meetings–including our annual congress, *Pharmacology*–and in gaining a reputation for excellence in the UK and overseas.

Also leaving us is Sue Giles, the Society's Accounts Administrator, who has been a part of the BPS team for almost eight years. Sue is a formidable, forthright and friendly presence around the office, and brought significant experience to our accounts function. The tough job of following Sue has gone to Amandeep Bhardwaj, who joined the Society as Finance Manager in February, having worked in a similar role for Nottingham CityCare CIC, a social, enterprise providing healthcare services within Nottingham.

Finally, Helen To, our Events Officer over the last two years, also parted company with the Society in February. Helen was a welcoming and helpful face in the office and at Society meetings, and will I'm sure be missed by all those who worked with her or encountered her at one of our events. We have appointed Susanne Schweda, previously Senior Events Co-Ordinator at the Royal Society of Medicine as Helen's replacement.

With all that change, I can assure you that the team at the Schild Plot will be focused on maintaining continuity and standards in the year ahead, and on delivering the important work we have ahead of us. So, all that remains for me to say is a huge thank you to those members of staff who are leaving us, and an equally big welcome to those who join the Society at this exciting point in its development.

Speakezee.org–A new way to speak easily to the public

Bruce Hood
University of Bristol

If you work in the higher education sector then you will have noticed an increasing emphasis on impact. Most of us in higher education are funded by taxpayers' money and those of us who are research active are dependent on grants to support our work. So it is understandable why the government and research councils have increasingly asked academics to disseminate research findings throughout society to achieve impact. This is not only true of pharmacology but all areas of science.

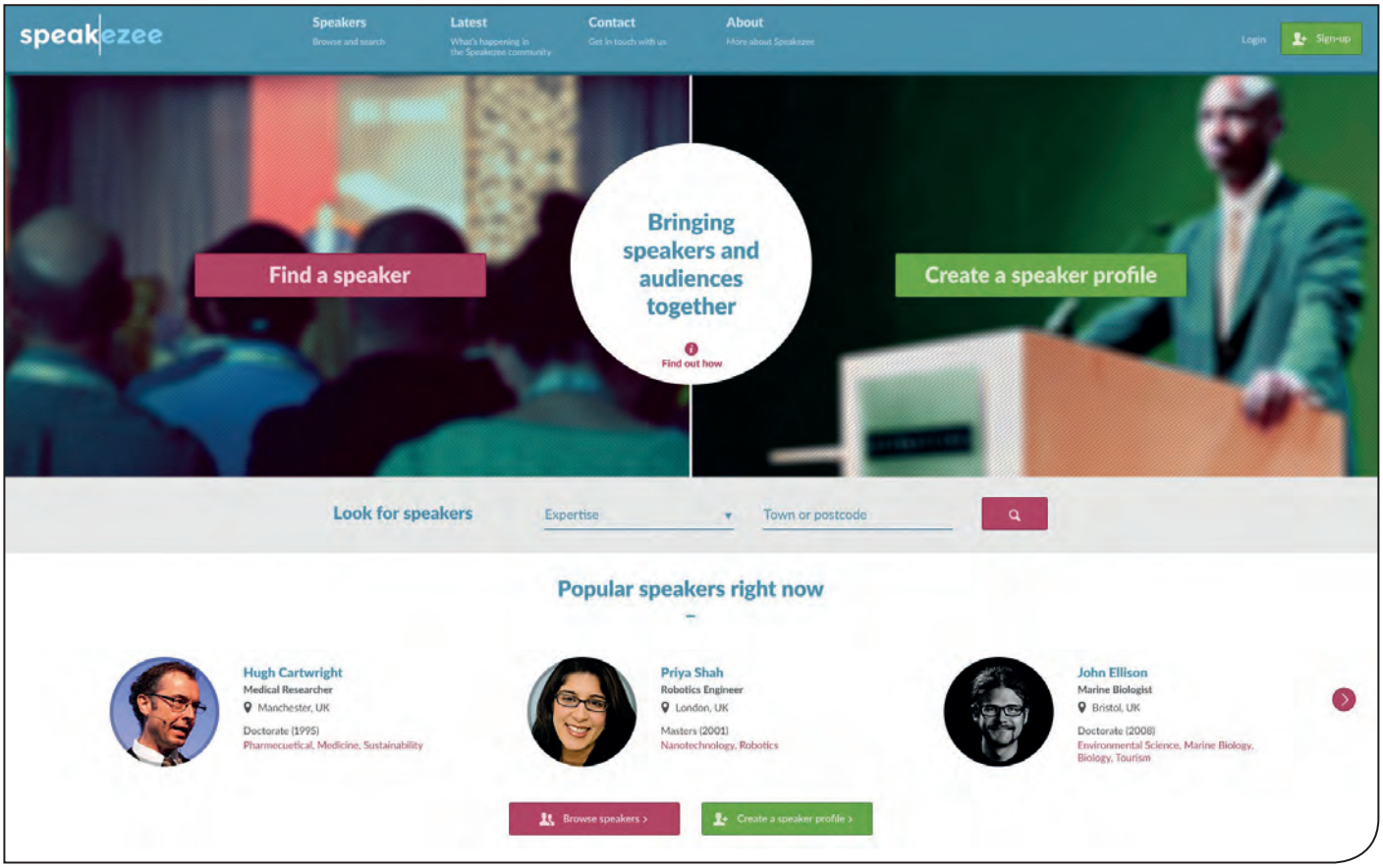
Impact also featured as one of the metrics of research success in the last Research Excellence Framework (REF), accounting for 20% of the overall evaluation. All the indications suggest that impact will continue to constitute a major component of an academic's professional development and promotion for the foreseeable future.

Measuring impact however, is problematic for many reasons. What constitutes an impact? Is it a discovery, an invention or a new procedure? My own experience and case study submitted for the REF was in the realm of public engagement (PE) and strategies to communicate the latest research from my own field of developmental neuroscience. For me, impact also includes communication with the general public and trying to change their beliefs about how the brain works.

I believe that there is clearly a lot more to impact than PE but I would point out that communicating with the general public is also a valuable marketing strategy for institutions that seek to promote their academics and raise awareness. However, science communication as a means of PE is not for everyone. Academics should not be forced to stand up and speak to general audiences if they genuinely do not enjoy the experience or are not particularly good at it. That said, there are additional good reasons why academics should at least consider PE to enhance their working lives.

First of all, the typical professional life of an academic is one of intermittent reinforcement that is often more negative than positive. Papers and grants take a long time to write, review and more often than not, are rejected. If we do give a seminar on our research to colleagues then the expectation is that it will be critically evaluated which, after all, is what scientists do. No wonder so many of us can find the experience stressful.

In contrast, giving a public talk can be a delightful, positive and immediate experience where an appreciative crowd is genuinely interested in what you have to say, and in general, less critical of the points one might make that one would never consider speculating on in a professional setting. The talks are often delivered in informal settings such as the backroom of a pub, which makes the atmosphere more relaxed for obvious reasons.



In the past, science communication has been focused on the young in an attempt to inspire them to take up science, but I believe we should also be targeting the general population as a whole. After all, these are the very people who can make important decisions about the future of science as a political issue.

So yes, speak to the schoolchildren but also speak to the networks of voluntary organizations such as the University of the Third Age, Probus, Women's Federation, Café Scientifiques, Skeptics in the Pub and the recently established Sunday Assembly–groups that are eager and keen to hear and engage in intellectual conversations and presentations.

Some of us in the science communication game already turn down more offers to speak than we could possibly accept. Many of the invitations require some distance of travel and yet grassroots organizations often cannot afford speaker fees or expenses. With that in mind, and the theme of pub settings, I have just launched Speakezee.org–a searchable database of voluntary academic speakers that connects experts with audiences.

I know that most scientists are passionate about their work and given half a chance would give rewarding talks. This is especially true of the young and enthusiastic early researchers who are already familiar with the power of social networking on the Internet. Speakezee.org is a free open-access system that can allow anyone to organize a pop-up lecture so long as they can find a reasonably sized group of fellow enthusiasts and a venue. Pubs are good as they are often quieter mid-week but also student societies and village halls can work well. With enough speakers on the database, it should be easy to find experts in every field, not just science, who are local and willing to give a voluntary talk.

When you login you will find a simple page that identifies you as a speaker or an event organizer and from there it is simple process of connecting the two. Speakers can create a profile page with a brief biography, areas of expertise and a suggested talk for a general audience (they can also provide a professional talk for colleagues trying to organize departmental seminars). If they have a video clip, then there is a show-reel section as well. Organizers can search by topic, location and availability. They can then make a request with further information that is either accepted or declined by the speaker. Eventually the system will enable feedback and comments on both speakers and organizations. It's free and simple.

With 12 million adults educated to degree level in the UK, I am hoping that Speakezee.org will stimulate the expansion of pop-up lectures for general audiences. Not only would Speakezee.org be a positive experience for both speakers and audiences, but academics will eventually be able to build up a reputation for communication that is rewarding in terms of professional development as well as personally satisfying.

About the author

Bruce is Professor of Developmental Psychology in Society at the University of Bristol where he has worked for the past 16 years. He obtained his PhD from Cambridge and worked at MIT and Harvard before returning to the UK. He is the Director of the Bristol Cognitive Development Centre researching into early child development and in 2011, presented the Royal Institution Christmas Lectures, "Meet Your Brain" broadcast on the BBC. Hood has published three popular science books on the brain and mind, is a life fellow of the Society of Biology, British Psychological Society, Royal Institution, Association for Psychological Science and the founder of Speakezee.org.

Discovery of pharmacology gold in the REF

Barbara McDermott
Queen's University Belfast

The dust has not quite settled on Research Excellence Framework (REF) 2014, the latest of the HEFCE-driven assessment exercises designed to show the quality of research taking place at UK higher education institutions, but nevertheless it's all over bar the shouting and everyone is a winner: 'Ranked No.1 in the UK, 'Consistently world leading', 'Top 50 for research power', these are just a few of the many rejoicing front page banners found on university websites at the beginning of the year. Of course, now that the funding formula has been announced, it is apparent that in real terms some institutions are in a losing position.

There have been hundreds of media articles published about REF2014 over the last few years, mostly exploring negatives, such as the how the REF driver can be used sometimes unfairly by university leaders in staff recruitment and management, the perceived curtailment of academic freedom, the undervaluing of teaching excellence and not least the large cost of the actual assessment estimated to be in excess of £1 billion. It is however not the purpose of this piece to add to these expressions of concern. Rather I will try to counter some of the other criticisms around the validity of the peer review process embedded in the 'expert' panels and, probably of more interest to this readership, look at the state of pharmacology as judged in the REF context.

Mulling over the results and derived statistics is very interesting now and it was also quite absorbing being a member of one of the assessment sub-panels (Biological Sciences) and contributing to the whole process. So, what was good about it? In a personal sense, it gave me a huge opportunity to engage fully with the subject over quite a long period, away from the tedious pursuit of meeting yet another administrative deadline. Assessment started in early 2014 in the familiar territory of reading scientific papers, a lot of them. Novelty, rigour and significance were the yardsticks applied, with citation count being used judiciously and only in a positive way to resolve borderline scores. Next, and with serious, disruption to summer holiday arrangements, came the deadline for decisions on impact case studies. It was on occasion not easy to work out timelines and institutional responsibilities, in which case audit could be requested. However many case descriptions brought out fascinating stories of achievement, which made this part of the assessment the most interesting. Lastly and just as the new academic year was starting, the schedule demanded examination in minute detail of the often densely worded environment statements concerning research strategy and funding, staffing and contribution. It was re-assuring that the whole process of assessment appeared to be rigorous and fair, as far as is possible. There were considerable periods spent undertaking calibration exercises to address hawkish and dovish tendencies and working in 2–4 person teams on finalising scores for outputs, impact and environment, with often extensive discussion of some of the finest points. As a final comment here, it came as an added bonus that the sub-panel built up a collegiality, often now missing in the university setting, but on the REF panel this made the huge amount of work that we got through just so much easier.

Just after the REF results were available on the HEFCE website on 18 December, there was a startling tweet posted by David Colquhoun from University College London, which stated quite simply that 'Pharmacology does not exist'. Well, at face value, this is true: pharmacology is not a discipline identified in any of the unit of assessment (UoA) sub-panel titles. All of medicine and life sciences was split between five of the six sub-panels within main panel A: Clinical Medicine (UoA1), Public Health, Health Services and Primary Care (UoA2), Allied Health Professions, Dentistry, Nursing and Pharmacy (UoA3), Psychology, Psychiatry and Neuroscience (UoA4), Biological Sciences (UoA5). It is not difficult to see that this structure posed a problem for submission from subject-specific units, such as Pharmacology/Therapeutics, but of course there are few such departments remaining, the researchers often aligned now with disease-based groupings.

So, with research likely to be identified in all of these UoAs, the question of how to get some quality measure posed a challenge, until a light bulb moment focused on the idea of looking at IMPACT. Assessing the impact of research on the basis of case studies was included first in this latest round of assessment and fortunately all of the cases submitted are now published on the REF2014 website, with the titles being searchable - what a great repository for information about a subject's reach and significance, which is how impact was judged. Choosing initial keywords was easy, 'drug' or 'pharmacology' or 'therapeutics' or 'biologic' brought out a fairly clean list of about 90 cases covering UoAs 1, 3, 4 and 5 (with a total of 1330 cases), most being in Clinical Medicine or Biological Sciences. It is also interesting that twelve cases were featured in UoA8 Chemistry. But what about case studies that included words like 'therapy' or 'treatment' in the title? This posed more of a problem as non-drug related cases had to be excluded. The final figure now including cases in UoA2 emerged as 275 (with a total of just less than 1,500 cases in UoAs 1–5). So this gives an approximate picture, likely to be underestimated, of the extent to which the whole endeavour of drug discovery, development, evaluation and utilization in this recent 20 year window has made a huge contribution to health and welfare in our society.

Medicine and the life sciences did very well in the overall grading of research compared with disciplines covered in the other main panels. This appeared to be down to better scoring on case studies and it seems likely that pharmacology constitutes a rich seam in the delivery of impact.

About the author

Barbara has been at Queen's University Belfast for most of her education and career, although has spent time away, firstly working in industry in Sheffield and later in sabbatical positions in Canada and the US. Barbara has a specific interest in the contribution of oxidative stress to myocardial remodelling and interaction with peptide signalling pathways. Now Professor Emeritus, Barbara fulfils a further role in promoting gender equality in scientific careers and study of sex-gender in pursuit of research excellence. Barbara has been Vice President - Meetings since January 2014.

A window into industry

Laura-Nadine Schuhmacher
University of Cambridge

Sara Pritchard
Takeda Cambridge

Sara Pritchard of Takeda Cambridge discusses the differences between industrial and academic research with PhD student Laura-Nadine Schuhmacher.

A few weeks ago, I travelled out by train to a village on the outskirts of Cambridge. A short car-ride later I found myself at the Science Park, an assembly of research units surrounded by fields and greenery, on their own website described as "rural, yet convenient". Here, I met up with Sara Pritchard, who recently started working for Takeda Cambridge, to talk about her career in the pharmaceutical industry and how she has experienced the difference in research between academia and industry.

Sara started her career at Glaxo now GlaxoSmithKline (GSK) in 1989, at a time when pharmaceutical companies had further education programmes in place that allowed school leavers to gain an education whilst on the job. This enabled her to gain a 1st class honours degree in Pharmacology whilst working full time. During her 21 years at GSK, she gained an impressive range of skills and experience in target identification, drug discovery and translational sciences for multiple disease areas. In 2010, after being made redundant from the Neurosciences Centre of Excellence for Drug Discovery, Sara decided to move to an academic environment to do a PhD full time at the University of Hertfordshire, which she finished in 2014 before joining Takeda in Cambridge.

Her in-depth knowledge of the pharmaceutical industry and experience of academia made her the ideal candidate for me to examine the differences between the two and what both sides could learn from each other.

When you started, the job requirements were quite different from today. What has changed?

When I started at Glaxo I didn't have a degree because I had had enough of the education system and just wanted to be working. In a highly skilled, resource-rich environment, the learning potential is huge and some of the best scientists I have worked with joined the industry as I did. The difference now is that people are frequently employed at the PhD/post-doc level with little opportunities for school leavers/new graduates. However, Takeda Cambridge does offer Higher Apprenticeships in Life and Chemical Sciences providing great opportunities for school leavers to work in the industry. I would like to see an increase in employment of school/college leavers as I think the industry is missing out on this untapped talent. There is more opportunity to return to the education system later if you want.

Talking about change, what differences did you experience when doing your PhD in an academic setting to how you were used to work at GSK?

The biggest difference is what you work towards. In academia, the drive is to produce publications, to build your external scientific reputation. I enjoyed the change in environment but felt restricted by resource limitations. It seems much harder in academia to reach your goals. In contrast, in industry, your aim is towards producing a commercially viable target, a drug that will make a difference to patients, before anyone else does. Every bit of your effort in industry is geared towards providing confidence in your target: the experiment must provide decision making data. In industry the most effective methods are generally used, these might cost a bit more but will get you to the target so much more efficiently. What I liked most about doing a PhD is the time it gave me to really think about things from a more mechanistic viewpoint. I had time to think about what I wanted to explore and which experiments were important to do. However a lot of my ideas and concepts had to be shelved due to a lack of resource.

The availability of resource and equipment is a big constraint in academia. Laboratories need to be financed by grant money, and this is secured through high quality research. However, in academia the quality of a scientist is defined by his or her publication record. Another big difference to industry?

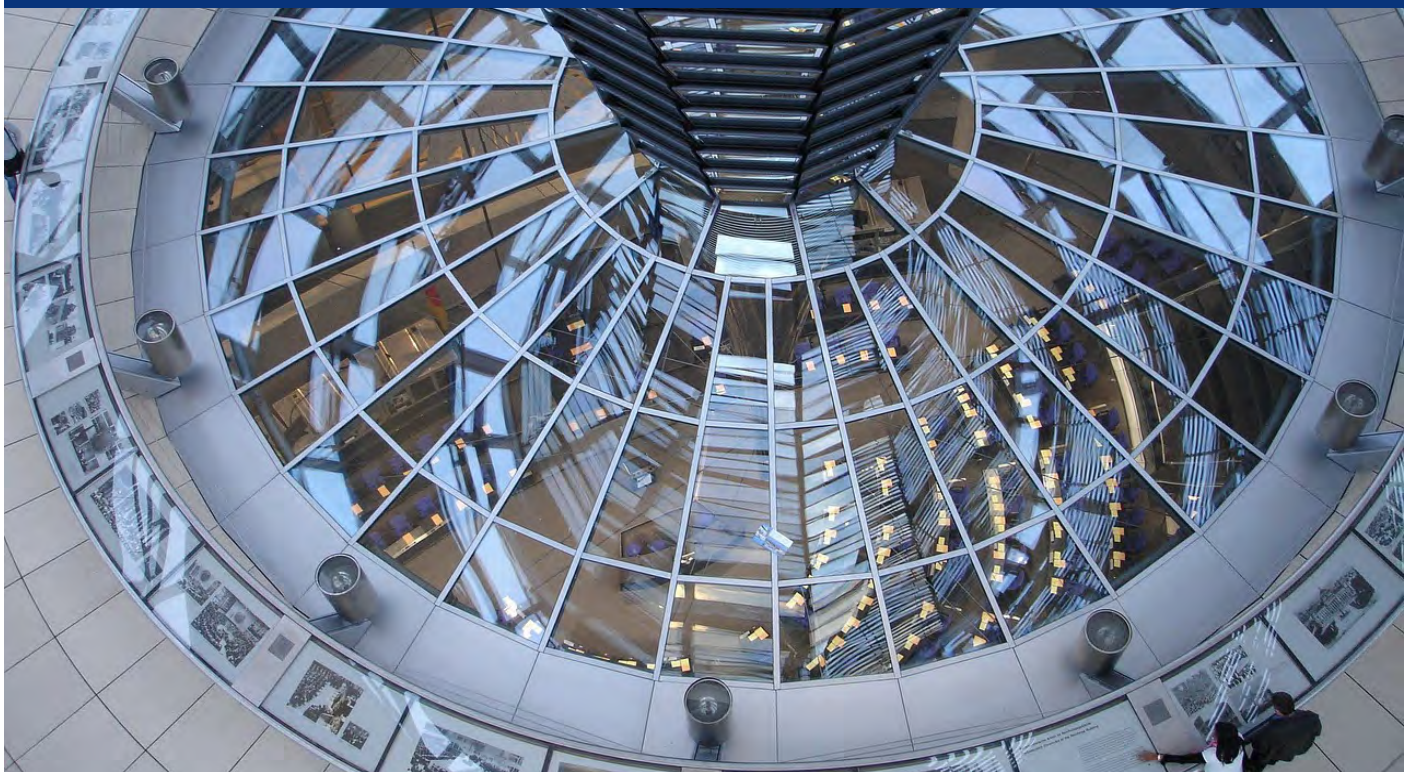
In the industry setting you are not encouraged to publish as much as I would like. That is something I am trying to address, to enable people to publish more. Many of us have read something in *Nature* that we have done years before but were unable to disclose to the public arena. In academia you get rewarded for what you publish, whereas in industry you are judged based on your actual real-time performance and how that has impacted your drug programme's progression. This builds your internal reputation and although you might gain a performance recognition reward it does little for your external reputation. The publication records of many brilliant industry scientists are weak in comparison to their counterparts in academia, which when job-hunting across sectors does hold us at a disadvantage.

The key issue in publishing in industry is the intellectual property of the information: whether publication would lose us a commercial advantage. You can produce the paper and 'park' it until such time as the problem has resolved. However there is so much that we do outside of this, for example development of new models, and I really want to encourage that here at Takeda Cambridge so we lead the way in industry publication. The amount of information that is generated in the pharmaceutical industry is staggering and deserves to be shared.

What kind of work are you doing at Takeda Cambridge?

This used to be company called Paradigm Therapeutics, which was acquired by Takeda in 2007. They established a different way of drug discovery that involves mouse phenotyping. As part of a broader platform, we continue to use transgenic knock in or knock out lines of the drug targets we want to explore and run them through a battery of tests. This enables us to work on proteins that haven't been explored as a target before, such as orphan receptors, which in many cases haven't been tapped in to by drug companies or academia.

Sara Pritchard offers a window into industry



What does a normal day of work look like for you? What are the proportions of laboratory work to management duties?

It's all very much hands on, including the team leader who is in the lab. So I would say on an average day it's probably 60–80% lab work, the rest is making presentations and going to meetings. Here, at a higher level, you are still in the lab, whereas at my university, the teaching demand on the lecturers was huge so the only research that they could do was through students. Takeda Cambridge is a relatively modest sized unit, and I think pharmaceutical companies increasingly try to replicate these small units. In my opinion they have the best atmosphere and best structure I've worked in: if you know everyone you're working with, your efficiency in getting things done is increased.

Do you get to follow up on your drugs when they get into clinical trial ?

I have been involved in the translational science right from the beginning. The first-time in human studies are based on your data from pre-clinical models. The strategy at GSK was to get things quickly into humans so you'd see if the target was engaged, and that way confidence in attaining efficacy was established quickly.

What is the success rate for drugs making it all the way onto the market?

The industry figures are that around 5–10% of new targets will progress from discovery to the clinic, while in the clinic a similar rate of attrition is experienced. The industry has done a lot to address efficacy, but getting drugs that actually work in humans is very hard. I've worked for years, and I haven't actually seen a drug all the way through to market.

How are the opportunities of moving sideways or upwards within Pharma?

Things get restructured and people are moved depending on their skills and what is needed. At GSK I asked to be moved a few times when I wanted to work on something else, and that always worked well for me. In terms of promotion, I did very well considering I didn't have a PhD then. In essence all I want is to enjoy what I do and who I work with. You have to be a certain type of person who is very driven, and that is recognized by industry. If you are very ambitious, progression upwards appears easier by jumping from company to company. There is lots of opportunity in industry and it seems harder to climb the ladder in academia.

What is the job security like?

Here (at Takeda Cambridge) it feels stable. In a large company you hear about parts of it being made redundant and it feels like a constant state of flux. This really impacts on how you feel about your job and that influences the way you work and your personal life. Here, it feels entirely different, I don't know if it's the company or my attitude towards work having been through redundancy already. However saying that everyone I know who's been made redundant has ended up doing really well.

So what does it take to be successful in industry?

You need to be a thinker and a doer. Technically very skilled, able, proactive, and of course intelligent. A good drug has to be designed on the basis of good science. But a little bit of luck helps!

The views expressed above are those of the individual and do not necessarily represent the views of Takeda Cambridge Ltd.

About the author

Laura-Nadine is a PhD student at the Department of Pharmacology, University of Cambridge, interested in the development and evolution of sensory systems. Her research is using Naked-Mole Rats as a model to study adaptations to life underground, specifically CO2 and acid insensitivity. Prior to coming to the UK, she investigated eye degeneration in blind cave fish at the University of Heidelberg, Germany.

Returning to a career in the biosciences after an extended break

Cat Ball
Biochemical Society
Science Policy Advisor

This article was first published in April's issue of the Biochemist.

The UK is facing a skills shortage. Everyone is saying it – from David Cameron to Paul Nurse – but what can we do about it? One potential source of talent lies within the so-called 'returners' community; those who have taken extended career breaks but often face difficulties in trying to return.

A career break can occur for many reasons such as the need to focus on caring responsibilities, illness, unemployment or a desire to change career paths (for example switching between industry and academia). Difficulty in returning from a career break affects those across the spectrum of science careers including teachers, technicians and industrial scientists.

Women are disproportionately affected by career breaks. Taking time out to care for children is one of the most commonly cited reasons why women are underrepresented at the upper levels of the career ladder. This is particularly evident in the biosciences; according to 2011/2012 HESA figures, 61% of postgraduate students were female, yet at professorial level this figure dropped to 15%.

There are a number of reasons behind why taking an extended period of time out can be particularly problematic for scientists of either gender. Firstly science is, by its very nature, a rapidly evolving and progressing subject. Techniques, theories and equipment can alter dramatically in a matter of years. Therefore returners can face real difficulties in remaining up to date.

The criteria by which the science community measures success, particularly in the academic research community can also pose a problem. Over-reliance on publication records and journal impact factors mean that a scientist who has not published continuously can often struggle to compete for research funding and permanent positions. However, career breaks were taken into account in the recent REF exercise so there is some evidence that this problem is beginning to be addressed.

Furthermore, the very culture of the academic science community can also cause a problem; part-time working can be difficult and the competitive nature of science can leave returners feeling shut-out.

So what can be done?

One initiative, imported from the States and being trialled in the banking sector in the UK, is 'returnships'. These act as a bridge back to senior roles for experienced candidates who have taken an extended career break. They are paid short-term employment contracts. The returner typically takes on commercially significant assignments based on their skills, interests and prior experience. The employing organisation gains from focused attention on business-critical issues and a low-risk opportunity to assess a potential employee's suitability for a permanent role at the end of the period, while the returner gets the chance to update skills, knowledge and experience in their previous sector/role or possibly to transition into a new area.

While the returnships model hasn't yet been trialled in the science sector, a number of schemes do exist to enable a return to an academic research career. The Daphne Jackson Trust offer STEM professionals wishing to return to research after a break of two or more years the opportunity to balance an individually tailored retraining programme with a challenging research project in a suitably supportive environment. Fellowships can be based in a university or research institute anywhere in the UK. The Biochemical Society sponsor a Daphne Jackson Fellowship as part of a suite of projects supporting women in science introduced during Women in Biochemistry year 2013.

The Wellcome Trust runs a similar scheme, the Career Re-Entry Fellowship, and the Royal Society's Dorothy Hodgkin Fellowship enables a flexible working pattern due to personal circumstances such as parenting or caring responsibilities or health issues. All of these schemes are open to both men and women, although female candidates are particularly invited to apply.

However more needs to be done to support the returners community and to convey the message to employers and Higher Education Institutions that returners are an untapped talent pool.

There are signs that the Government is beginning to take this message on board. Returners featured in the recent Science and Innovation strategy released by the Department for Business, Innovation and Skills and HM Treasury in December. As part of the strategy to nurture scientific talent, the Government plans to develop a dedicated platform to match female STEM graduates to return to jobs in industry following career breaks, and to provide them with advice and information about the support on offer.

The Society of Biology has established a 'Returners to Bioscience' group to examine the experiences of those who face such difficulties in returning to a career in the biosciences. This is in light of continued concerns about the loss of trained and committed scientists from the bioscience workforce.

The group, which features representatives from funders, employers, learned societies (including the British Pharmacological Society) and a number of former 'returners' themselves, seeks to provide resources and mechanisms to support scientists before, during and after a career break. For further information about the Society of Biology's Returners to bioscience initiative, or if you would be interested in providing a case study, please get in touch (policy@biochemisty.org).

Career break membership

BPS members taking extended leave from work can apply for one year's free membership, with an option to apply for a further 12 months upon request. Please check the website (www.bps.ac.uk) for eligibility.

About the author

Dr Cat Ball works between the Society of Biology and the Biochemical Society as a Science Policy Advisor. She largely focuses on cross-sectoral issues including antimicrobial resistance, equality and diversity in science, drug discovery and science policy in Scotland.

Young pharmacologists update

Dan Reed
Member of the Young Pharmacologists Advisory Group

Tim Warner
Chair of the Young Pharmacologists Advisory Group

It was our pleasure to organise the Welcome Reception and host the inaugural Student Choice Award for Excellence in Pharmacology Teaching evening at *Pharmacology 2014*.

The younger members section now represents a third of the total membership of the Society. As the number of undergraduate students in the UK continues to grow, the importance of excellent teaching to secure the future of pharmacology also increases. The younger members of the Society have all been inspired at some point by an exceptional teacher, in some cases multiple exceptional teachers, and we wanted to introduce an award through which these individuals could be recognised.

We also wanted to ensure that it was the younger members themselves, those receiving the teaching, who selected the nominees. To do this we asked our student members from individual universities to nominate their best teachers and were incredibly impressed by the strength of applications we received. It was a real challenge to narrow this down to the final four who we invited to attend the Reception during *Pharmacology 2014*. Each nominee was accompanied by nominating students who spoke for a few minutes in support of their teacher. In a close run competition we were delighted to announce Dr Christine Edmead from the University of Bath as our winner, and to thank Elizabeth Mann for her excellent nomination.

We were thrilled by the success of the evening and very much look forward to reviewing applications for this year's award and hosting the Welcome Reception for *Pharmacology 2015*.

> *"It was an honour to have been nominated by my students and to have received this award. I hope I can also speak for the other nominees when I say that it was lovely to hear the students' perspective of their learning experiences and to understand how our practice and approaches are inspiring a new generation of pharmacologists. The evening was a wonderful opportunity and occasion to celebrate pharmacology. I hope that the awards and associated publicity will serve to promote and strengthen teaching, not only within our own discipline, but that through dissemination, the innovations and approaches will be adopted more widely to enhance teaching practice across the H.E. sector."* ***Christine Edmead, University of Bath and inaugural winner of the excellence in pharmacology teaching award.***

> *"I didn't really know what to expect from the evening to begin with, but I was certainly impressed by the venue. I was the first nominator to speak and, though I felt very nervous, I really enjoyed myself in the end. It was a brilliant moment when it was announced that Christine had won the prize and the networking afterwards was equally enjoyable and rewarding. This was a great opportunity and a fantastic experience"* ***Elizabeth Mann, University of Bath.***

From left to right: Maria Fernandes, Dan Reed, Elizabeth Mann, Christine Edmead, Tim Warner, Laura Ajram and Liz Rosethorne

Students from four universities, spoke in support of their teachers

Elizabeth Mann celebrates with her teacher Christine Edmead

Report on the President's Lecture: 'New medicines: A vital, but risky, business'

Aisah Aubdool
King's College London

This year, the British Pharmacological Society's President's Lecture: 'New medicines: A vital, but risky, business' was delivered to a large audience at the Royal Society in London, by Dr Patrick Vallance, the President of Pharmaceutical R&D at GlaxoSmithKline (GSK), UK. Dr Vallance has over 20 years experience of clinical medicine, general internal medicine, cardiovascular medicine and clinical pharmacology.

The opening of this lecture reminded the audience that his inspiration for pharmacology was sparked during his years as an undergraduate student, which led to him joining the Society, his first ever scientific society. His seminar stimulated a lively discussion of the prospects for real innovation at the cutting edge of drug discovery and development. He highlighted that clinical scientists are a very rare breed and explained how, out of serendipity, curiosity and change, he progressed from leading an active academic research department at University College London to his current role heading R&D operations at GSK.

BPS President, Humphrey Rang awarded Honorary Fellowship to Dr Vallance after the lecture

Notably, Dr Vallance reminded the audience that behind the current world-changing medicines lie many years of drug discovery conducted by the pharmaceutical industry, built on a foundation of basic research from academia. He emphasised the critical role of pharmacology in understanding the pharmacokinetics, behaviour and actions of molecules in drug development. The pharmaceutical industry has not escaped the current economic crisis, and this was evident in this lecture, which described the challenges facing pharmaceutical companies, and rigorous changes in pricing that are affecting the pharmaceutical business model.

Dr Vallance's tenure at GSK has been turbulent and challenging, for example in facing the vocal critics of current marketing strategies. Many newly developed drugs and drugs in the pipelines face financial, societal and personal risks, but the aim of the research strategy and business model is to keep the science risk low, which will reduce the financial risk in the long term. A key quote from Dr Vallance's lecture was *'A ship is always safe in harbour but that's not what ships are built for,'* which eloquently highlights the current innovative climate in the pharmaceutical industry.

This lecture was followed by a lively discussion facilitated by Sir Michael Rawlins, President of the Royal Society of Medicine and chaired by Professor Julia Buckingham, Vice-Chancellor and Principal of Brunel University London. In this session, Dr Vallance reinforced the importance of being familiar with your target, population, effect sizes and regulatory policies. He also emphasised the need for pharmacologists to be active in small companies and academia, contributing their expertise to growing areas such as integrative biology and the development of gene- and cell-based therapies.

This excellent lecture concluded with Dr Vallance being awarded Honorary Fellowship of the British Pharmacological Society in recognition of his sustained leadership role in pharmacology.

You can watch the President's Lecture in full from our YouTube channel
www.youtube.com/watch?v=uuDgZY-Tnuo

About the author

Aisah obtained her BSC in Pharmacology in 2009 before completing an MRes in Integrative Biomedicine in 2010 and her PhD in Cardiovascular Medical Research, funded by the flagship Centre for Integrative Biomedicine at King's College London in 2014. Her current postdoctoral research project, in Professor Susan Brain's lab at King's College London, is investigating the effects of a novel stabilised αCGRP analogue in hypertension.

Vote Science

Mark Downs
Chief Executive of the Society of Biology

While the summer still feels like a way off, the General Election is starting to loom large. There will be a new Government before we know it and, irrespective of whatever flavour it comes in, there will be huge challenges for the scientific community around the need to demonstrate value for money and even in maintaining current funding levels.

The widespread relief at a "flat cash settlement" for science in the last funding round has slowly turned to concern that inflation has wiped out over £1 billion for UK research. At the time, the Society of Biology was one of only a few organisations to publicly voice concern.

We all recognise that there are major economic challenges ahead but investment in science is part of the solution not part of the problem. We too often knock the UK research base for a failure to translate research into new products and services led by UK business. Although we must always aim for more, the reality is that we have many great examples of success and our strength in science is a beacon for overseas students and researchers. This is our historic record. Looking to the future, if we don't quickly regain lost investment that strength may wane, and that's why the Society of Biology will continue to campaign hard up to and beyond the general election as policy for science, and its funding, starts to evolve.

In March, we organised three major science events within the Houses of Parliament at Westminster including a science policy debate between the main parties. We have a dedicated page on our website (www.societyofbiology.org/sage15) with key facts and messages you can use at local events or with parliamentary candidates: the more local activity the better.

It is important to present a united front for the science community working in partnership with colleagues in chemistry, physics, mathematics and beyond. Governments love to "divide and rule" so it is in no one's interest to present divided or conflicting messages. For us, unity starts with the bioscience community and we urge all of our Member Organisations like BPS to engage with our policy team as much as possible to ensure biology has a single voice.

Of course, research does not take place in isolation. It is underpinned by an excellent and integrated education system, the right regulatory framework and an appropriate business environment to attract and retain investment. All of these areas along with environmental and biodiversity policies will be critical to assessing the new Government's overall commitment to science, evidence-led policy making and science-based industries.

There can be no doubt that the recent Research Excellence Framework (REF) exercise (www.ref.ac.uk) has demonstrated the incredibly diverse value of science, with the life sciences faring particularly well. These messages need to be made clear to Parliamentary candidates who may well not have any background in the sciences: but not in isolation. If we invest in science but not in education and training, or try to artificially separate them, the outcome is not likely to be a good one. There remain rumours that higher education will be given to the Department for Education post-election, separating it from research. I'm sure this is something we would all have concerns about and we will be monitoring the situation closely and making our views clear.

Last year we celebrated our fifth birthday, and we are now turning our minds to the next five years. We are keen that the work we undertake on behalf of the sector reflects the priorities in our diverse Member Organisations like BPS. We are pulling together the first draft of our future plan with a view to finalising it in June. If you have views on what you would like to see more of or where our priorities should lie, we would love to hear from you. Please feel free to email me markdowns@societyofbiology.org.

About the author

Mark has been CEO of the Society of Biology since 2009. Mark has a PhD from Cranfield University where he worked on the development of DNA sensors for rapid gene identification.

We organized three major science events in March including Voice of the Future 2015

Describing complexity (through art and science)

Kathryn Garner
University of Bristol

One of the most important pieces of advice my tutor at art school gave me was that if it's boring, it's not worth doing. The other was how to make a painting using a limited number of colours so that the work doesn't resemble a pavement outside a nightclub on a Sunday morning! I was in the third year of my BA in Fine Art at Falmouth College of Arts (now University College Falmouth) at the time, and had spent the previous two weeks working on a complex painting of a friend with a 1970s-style flowered shirt (every flower was to be perfectly rendered). That piece was never finished.

Much of my earlier work at school and at college had focused on natural, often biological forms. Most were abstract; they were often close-up investigations of detail, texture and surface. I have spent hours meticulously cataloguing all of the different tones and colours in a single leaf, every crease in a crumpled piece of white paper, and describing every fibre in a piece of tree bark. In my first year at Falmouth, I sought fresh inspiration in the biology section in the library, finding a particular affinity with images taken using microscopes. The book that changed everything was 'Gray's Anatomy'. The edition in our library was large and heavy with an embossed leather cover, thin pages with gold edging. Images in this book fed a large body of my work: the 'Cell paintings'. I found that the more complex the image, the more it fascinated me. I loved the highly coloured histology pictures of tissue sections the most, with their legends that were completely foreign to me.

Unfortunately my energy for making these paintings began to dissipate as I became dismayed that I was unable to make the images myself; I did not understand how microscopy images were made, nor did I have the means to view the specimens first-hand. Instead I began to search around for an alternate subject matter able to pique my interest. I showed a series of oil paintings in my final year, which were close-up images of skin, hair and eyes – the nearest I could get to microscopic life.

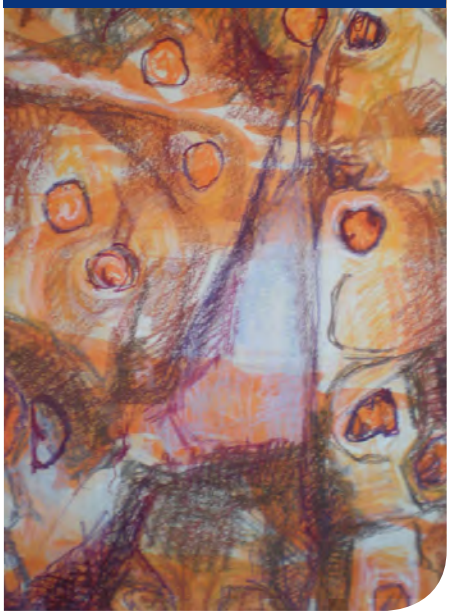
After leaving art school, I took a job working on an insect farm in Essex. The company bred crickets, locusts and mealworms for sale to petshops and individuals as reptile food. I asked lots of questions, many more than any of my colleagues, and eventually was invited to help with some experiments into the optimum breeding conditions for crickets. This I loved: every morning and evening I recorded temperature and humidity data, and was even given time off of my normal packing duties to write up the data into a spreadsheet. This experience, coupled with a lingering desire to learn more about the microscopy images of cells that I had made paintings about at art school, led to evening classes in Chemistry and Biology, a new job as a laboratory technician in the cryolab of a leading infertility clinic in London, and eventually a BSc in Molecular Cell Biology and PhD at University College London.

In June 2012, I was finally ready to submit my PhD thesis. By chance, I read an email which had been sent throughout UCL: a call for abstracts for an upcoming symposium at Wimbledon College of Art, 'Thinking Through Drawing: Drawing in STEAM'. (STEAM of course refers to the STEM subjects, Science, Technology, Economics and Maths, with the addition of Art.) Drawing is a fundamental part of the making or creating process. We traditionally think of drawing as pencil marks on paper,

Compartmentalisation (2012) Pencil, watercolour and white chalk on paper, 81x56cm

Groynes and Keys (2014) Pencil and watercolour on paper, 30x42cm

Orange Cell Drawing (2000) Mixed media on paper, 60x84cm



Purple Cell Drawing (1999) Ink and emulsion paint on paper, 60x84cm

maybe arranged to create a recognisable image. However, for the maker, the finished image might not be their purpose. Instead, the act itself allows the opportunity to engage with a subject, to turn it inside out and to understand how it works. A drawing doesn't need to be created using pencil on paper – any material capable of making a mark, such as charcoal, paint, biro, on any type of ground capable of taking a mark – wood, sheet metal, plaster on a brick wall. A drawing doesn't even have to be two-dimensional: a three-dimensional structure might more easily be explored using wire or twigs and glue. A drawing is the first means by which thoughts can be visualised.

I considered this further; scientists spend a large amount of time thinking – about theories, and planning time and experiments. I looked through my notebooks from my PhD and found lots of different types of drawing: molecular mechanisms, either hypothesised or copied from the literature, experiment plans and cell signalling pathway drawings. My supervisor, Professor Shamshad Cockcroft and I would make drawings on whiteboards on the wall, or on paper, as we discussed experiments or planned papers. I wondered how many other scientists made drawings like this that they weren't even aware of, so I wrote this observation up into an abstract for a paper, which I was chosen to present as a talk at the symposium. The paper was finally published at the end of last year in *TRACEY Journal*, a drawing and visualisation research journal published by Loughborough University.

I currently work as a Research Associate in Hormone Signalling at the Laboratories for Integrative Neuroscience and Endocrinology (LINE) at the University of Bristol, in the group of Professor Craig McArdle. We work alongside mathematicians, Drs Amitesh Pratap and Margaritis Voliotis, and Professor Krasimira Tsaneva-Atanasova (University of Exeter), to use systems approaches to understand signalling downstream of the neuropeptide, gonadotrophin-releasing hormone (GnRH). My work centres around monitoring the modification (phosphorylation) or re-localisation of particular signalling components using automated fluorescence microscopy, which yields single cell data. I am currently using several cell lines in my work: HeLa (a human cervical cancer line and the first cell line created), MCF-7 (a breast cancer line), LβT2 (a gonadotrope-derived line), and HEK-293 (a human embryonic kidney line). All are adherent, and I realised that one way to involve drawing in my daily activity is to make use of the five-minute trypsin reaction. Instead of watching the clock or staring out of the window, I use this time to sketch some cells. At art school we would do one-minute drawings as a way to stop thinking about the process – to stop worrying about the quality of every mark. The HEK-293 cells I am growing at the moment have spiky protrusions that make the cells look to me like a multitude of islands, with harbours and inlets, or groynes stretching out into the sea. My journey through science has taught me that cells are so much more than a series of different shapes, of light and dark tones.

I fell in love with cell signalling whilst sitting in a lecture by Professor Steve Bolsover in my first year at UCL. He was describing the MAP kinase cascade, how one protein binds to and phosphorylates another protein, how this one, now activated, binds to the next protein in the cascade, so modifying and activating this, and so on to communicate a message from the environment into the cell to elicit a response. A cell is a complex entity, teeming with proteins, each with a specific job to perform. Proteins are miniature machines that might be tasked with transportation of particular cargo from one part of the cell to another, with carrying a message, keeping out foreign invaders or making new cell components. These are all concepts that I am now working with in my artwork, using metaphors of familiar concepts to describe unfamiliar things; a cell might be likened to a city, a transport hub, a beehive, ant's nest or computer circuit board. All of these entities come with built-in notions about transport networks, information transfer, defence, energy production and compartmentalisation of processes.

For as long as I can remember, I've wanted to understand more about life. My training in art has taught me the importance of listening to who I am, of staying true to what is really interesting to me, and has given me the motivation for independent learning. Science has since given me the tools to explore life beyond the reach of art. Art gives me the means to describe what I have discovered. For me, one cannot exist without the other.

About the author

Kathryn is a Research Associate in Hormone Signalling at the University of Bristol. She writes a blog about Painting, Drawing and Molecular Biology at www.kathryngarner.co.uk/blog.

Meetings update

Barbara McDermott
Vice President-Meetings

Karen Schlaegel
Head of Meetings and Events

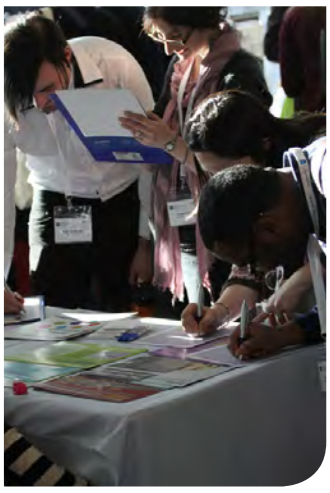
Pharmacology 2014, 16–18 December 2014

On behalf of the Meetings Committee, we would like to thank everyone who contributed to the success of *Pharmacology 2014*: symposia organizers, speakers, sponsors and exhibitors, abstract reviewers and of course all participants.

Participant numbers continue to rise year on year and it was wonderful to be able to welcome more than 1,000 attendees! The feedback received on site as well as through the online survey continues to be very positive with 95.5% of surveyed delegates very/satisfied with the symposia speakers and 87% with the programme overall and 97.5% liked the meeting's location.

We welcomed and considered suggestions received about improving the layout of the exhibition area. Unfortunately it is not possible to have all posters and exhibitors in the same room due to the (increasing) number of posters and exhibitors that need to be accommodated. Most attendees were happy with the lunch and coffee break timings, which allowed plenty of time for meeting with exhibitors, colleagues and making new contacts.

We welcomed more than 1,000 participants to *Pharmacology 2014*



Pharmacology 2014: on site feedback

Excellent lectures

I thoroughly enjoyed attending the meeting. Content, prize lectures, balance between sessions and timings all worked well. Enjoyed my packed lunches too.

Great location, well organised, good breadth of subject areas.

Brilliant organisation, great dinner venue and quality of food and drink.

Venue is excellent, encourages mingling of delegates in a pleasant, not too crowded area. Refreshments encourage enthusiastic poster discussions even up to 4pm on last day.

Pharmacology 2015, 15–17 December 2015

The success of the last annual meeting was mirrored in the number of symposia proposals we received for *Pharmacology 2015*. From 12 proposals in 2013, to 21 last year, Meetings Committee had the luxury of choosing from 31 high-quality submissions this year! With only 12 slots available it was no easy task and our thanks go to everyone who took the time to submit a proposal.

The draft programme has now been confirmed:

Track 1: Cardiovascular & Respiratory Pharmacology

Tuesday: Airway pharmacology

Wednesday: Targeting cardiotoxicity

Thursday: Perivascular adipose tissue and regulation of vascular function

Track 2: Neuropharmacology / Integrated Systems Pharmacology

Tuesday: Targeting cognition: a panacea for neuropsychiatric disease?

Wednesday: CGRP and migraine: from basic science to potential for new drugs

Thursday: Identifying targets for the novel treatment of arthritis pain

Track 3: Molecular & Cellular Pharmacology

Tuesday: The hydrogen sulphide pathway as a therapeutic target

Wednesday: Modulating protein-protein interactions for therapeutic benefit

Thursday: Stuck in the membrane with you: The influence of drug-phospholipid interactions on receptor pharmacology

Track 4: Drug Discovery, Development & Evaluation / Toxicology

Tuesday: Micro RNA: new diagnostics and new therapies

Wednesday: UK Medicines: regulatory science and innovation

Thursday: Paediatric clinical pharmacology: Successful planning and delivery of early phase studies in children

Workshops:

Thursday: Refining animal models: the expert working group model

Quantitative Pharmacology

BPS Affinity Groups

The Affinity Groups will play a central role in encouraging networking and discussion between members, and encompass the areas previously defined by the Society's Special Interest Groups. We are pleased to announce the Co-Chairs of our new Affinity Groups:

Neuropharmacology:

Mark Tricklebank (King's College London) and Clare Stanford (University College London)

Molecular and Cellular Pharmacology:

Steve Safrany (University of Wolverhampton) and Gary Stephens (University of Reading)

Cardiovascular and Respiratory Pharmacology

Emma Baker (St George's London) and Chris Garland (Oxford University)

Integrative Systems Pharmacology

Niall Hyland (University of Cork) and James Fullerton (University College London)

Education and Skills

Michael Seed (University of East London and member of the BPS Education & Training Committee) and Andrew Webb (King's College London)

Toxicology

James Dear (University of Edinburgh) and Daniel Antoine (University of Liverpool)

Drug Discovery, Development and Evaluation

Liz Rosethorne (University of Nottingham, formerly Novartis) and Dave Kendall (University of Nottingham)

If you haven't already done so, we invite you to sign up to the Affinity Group(s) most relevant to your work and interests. You can do this in the Members' area of the website.

The year ahead:

BNA Festival of Neuroscience, Edinburgh, 12–15 April 2015

Focused meeting: Exploiting the new pharmacology and application to drug discovery, Edinburgh, 20–21 April 2015

Joint ASCEPT-BPS Scientific Meeting: Tomorrow's medicines: pharmacology, patients and populations, Hong Kong, 19–21 May 2015

21st Scientific Symposium of the Austrian Pharmacological Society - Joint meeting with the British Pharmacological Society and the Pharmacological Societies of Croatia, Serbia and Slovenia, Graz, 16–18 September 2015

Stratified medicine and prevention of adverse drug reactions - Joint Meeting of the British Toxicology Society and the British Pharmacological Society, Edinburgh, 5–6 October 2015

Please check www.bps.ac.uk/meetings for further information.

Finally we would like to let you know that, after two years at BPS, Helen To, our Events Officer, left the Society in February. Many of you will have met Helen at BPS meetings and will remember her for the friendly and professional manner in which she handled any requests and enquiries. We would like to thank her for the work she did for the Society and wish her all the best for her future.

If you have any questions or suggestions or would like to get involved with the BPS meetings, please do not hesitate to contact us at meetings@bps.ac.uk.

We look forward to welcoming you at one of our meetings in 2015.

BPS journals: Editors' picks

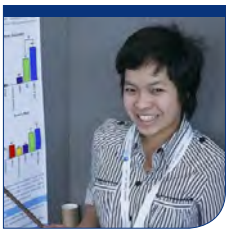
Review Editors' picks, selected articles from the British Journal of Pharmacology and British Journal of Clinical Pharmacology, at bit.ly/1CT6v22

BPS Journals: on Twitter and Facebook

Follow *BJP* (search: *BrJPharmacol*) and *BJCP* (search: *BritJClinPharm*)

Like *BJP* (search: *BrJPharmacol*) and *BJCP* (search: *British-Journal-of-Clinical-Pharmacology*)

How do vessels react in response to local cold exposure? Why this phenomenon is important and its clinical impact



Xenia Kodji
King's College London

Aisah Aubdool
King's College London

Adverse exposure to cold weather is associated with local cold injuries, such as frostbite. The human body is known to have several defence mechanisms to boost its core body temperature following exposure to cold. The initial response consists of vasoconstriction whereby cutaneous blood vessels narrow to constrict the supply of blood and retain body heat. This is subsequently followed by vasodilatation, whereby the blood vessels are widened and more blood flows to the surface of the skin. This process is important for rewarming the skin, reducing heat loss whilst ensuring extremities' blood flow is back to normal to keep a healthy vasculature. This rewarming response is impaired in patients with peripheral vascular diseases.

This phenomenon of cold-induced vasodilatation (CIVD) was first described by Sir Thomas Lewis (1930)[1] and widely studied in peripheral areas including elbows, knees, buttocks, palmar surfaces of the fingers, palms of the hands and the sole of the foot[2]. Amongst all sites, the skin itself is known to play an important role as a thermo-detector, with the peripheral cold afferent nerve endings present between the dermis and epidermis at approximately 150μm from the skin surface[3]. Prolonged exposure to wet and cold can damage nerve and tissue, leading to pain. Trench foot is a common example of non-freezing cold injury[4]. Despite heavy debate, the mechanisms underlying this response remain unclear and the cutaneous thermosensitive components are unknown. Several studies have focused on sympathetic constrictor mechanisms as a primary driver with some evidence of sensory nerve[5].

Our research has focused on understanding how the sensory nerves are involved in this response as they are essential in detecting environmental factors, such as temperature. Electrical and chemical stimulation of the slow-conducting C-fibres can result in increased blood flow, mediated by neuropeptides namely substance P and calcitonin-gene related peptide (CGRP). CGRP is known to be a potent microvascular vasodilator, as shown by intradermal injection in femtomole doses ion the human forearm[6]. The lack of reflex vasodilatation observed in Raynaud's patients was shown not to be due to a lack of responsiveness to CGRP in the cutaneous microvasculature, but possibly due to a defect in the local axon reflexes[7].

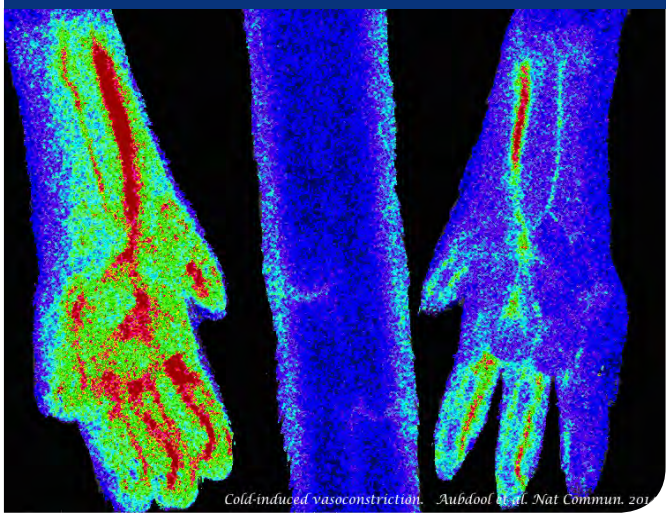
Understanding the biology of sensory nerves remain essential and has been enhanced with the discovery of transient receptor potential (TRP) channels widely expressed on these nerves. Our group has studied the role of transient receptor potential Vanilloid 1 (TRPV1) when activated by the hot chilli extract, capsaicin and noxious heat (>43°C)[8] and transient receptor potential ankyrin-1 (TRPA1) when activated by mustard-oil, cinnamaldehyde[9] and noxious cold (<17°C)[10]. It is known that TRPA1 is involved in mediating cutaneous vasodilatation via activation of sensory nerves in response to the endogenous agonist, 4-oxononenal[11]. However, TRPA1 has been linked to pain sensitivity and is currently being used in the development of painkillers for patients with painful diabetic neuropathy (GRC17536, Glenmark).

What have we done?

Although cold temperatures (<17°C) can directly activate TRPA1 in heterologous expression systems[10], this remains a controversial issue, as there are other thermo-sensitive TRP channels and the role of TRPA1 as a thermosensor in vascular responses is currently unexplored. We addressed this issue by designing an acute local cold model in the mouse that responded similarly to earlier human findings, to investigate the mechanisms underlying cold-induced vascular responses *in vivo* at a non-freezing temperature (10°C), which is hypothesised to selectively target the temperature window of TRPA1 activation. In our study conducted at King's College London, we exposed the skin of anaesthetised mice to cold by immersing the hindpaw in cold water. Blood flow was measured prior to and following a cooling period using laser speckle imaging.

We showed that local cold exposure induces a transient vasoconstriction followed by a vasodilator response, which is essential to restore blood flow to baseline (Figure 1). Our results demonstrate that TRPA1 acts as a major vascular cold sensor, with a second channel TRPM8 also involved, through studies involving pharmacological antagonism, gene deletion, and biochemical signalling. Firstly, TRPA1 senses the change in temperature; mediating the cold-induced vasoconstriction via TRPA1-dependent mitochondrial superoxide production that stimulates a specific downstream biochemical signalling pathway involving translocation of α_{2c}-adrenergic receptors and Rho-kinase mediated phosphorylation of myosin light chain (MLC). The subsequent highly important vasodilator phase that restores blood flow, and maintaining healthy skin, is also dependent on TRPA1 activation.

Figure 1. Effects of local cold exposure on blood flow responses in the hindpaw vasculature, measured by laser speckle imaging



In this case there is a stimulation of sensory nerve-derived dilator neuropeptides CGRP and substance P, and also neuronal nitric

oxide synthase (NOS)-derived nitric oxide (NO) that act to replenish the blood flow and protect against cold-induced injury. Whilst TRPA1 is known to be involved in mediating vasodilator responses, this is the first study to highlight its role in inducing vasoconstriction in the peripheral vasculature in response to local cooling.

How is this relevant?

The corresponding author Susan Brain, Professor of Pharmacology in the BHF-Cardiovascular Centre of Excellence at King's College London, states that these results introduce a new paradigm whereby TRPA1 plays an essential physiological role, acting in two distinct ways to first sense and then elicit a successful vascular protective response to local noxious cold exposure. This mechanism underlying the constrictor component of cold-induced vasoconstriction may be important in understanding the pathophysiology of Raynaud's phenomenon, which is characterised by a prolonged increase in cold-induced vasoconstriction, and lack of vasodilator response in digit areas of the fingers and toes. Our study further provides impetus for further research into developing therapeutic agents aimed at the local protection of the skin, and loss of heat in disease and adverse climates.

Future Studies: What needs to be done now?

Our research highlights that TRPA1 acts in two distinct ways: first by sensing the change in temperature and then by stimulating the protective rewarming response. The next steps are to build on these findings to learn more about the extent of the role of the different TRP receptors and to investigate the relationship between the vascular responses to cold exposure and the maintenance of skin and body temperatures. These results will allow us to speculate that we may be able to develop new drugs that may limit the adverse effects of peripheral exposure to noxious cold and in turn the whole body cooling associated with hypothermia.

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Aisah A Aubdool is a BHF-funded post-doctoral scientist in Professor Susan Brain's lab at King's College London. Aisah has a very keen interest in TRP channels and neuropeptides, focusing on TRPA1 and CGRP in the vasculature, and this recently-published paper formed a part of her BBSRC-funded PhD project.

Veterinary medicine needs new and innovative green antimicrobial drugs

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To mitigate any contribution of veterinary antimicrobial drug (AMD) therapy to the global problem of antimicrobial resistance (AMR), one option is to apply the *precautionary principle*. This might involve prohibition of some AMD usages in animals and/or restriction of the use of some critical drugs to humans, recognising that this is a non-scientific approach. A second option is to rely on the *prevention principle*, comprising positive actions, such as revision of dosage regimens, increased application of antimicrobial susceptibility testing and the preferential use of narrow spectrum AMDs. Collectively, these approaches ensure the so-called prudent uses of veterinary AMDs. Neither of these approaches provide a full answer to the veterinary contribution to the human AMR problem, as they are directed only at optimising eradication of veterinary pathogens. They take no account of the fact that the main sources of resistance determinants do not derive from pathogenic microbiota but are attributable to the commensal microbiome.

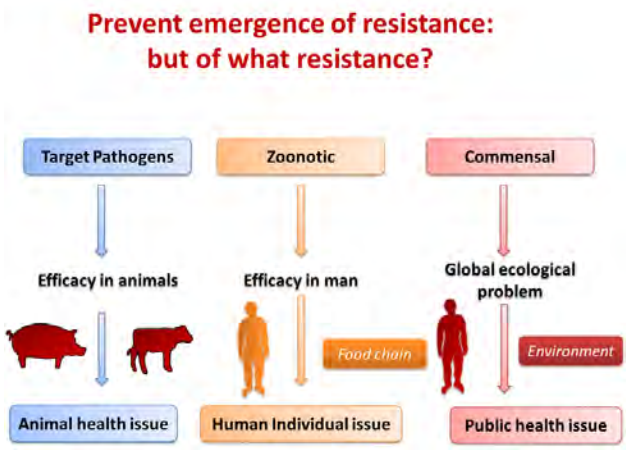
This review proposes that veterinary medicine urgently needs novel AMDs, not for animal health reasons but because most of the currently used AMDs ineluctably impact the animal gastrointestinal tract (GIT) microbiome/mobilome through their lack of selectivity in both action and distribution. AMR of veterinary origin should be viewed as a global ecological challenge rather than a veterinary therapeutic issue. The term *"green antibiotics"* is proposed for novel classes of veterinary AMDs, to emphasise that their key characteristic will be to exert no or minimal ecological impact on the GIT and environmental resistomes.

Veterinary medicine faces three types of AMR: for specific veterinary pathogens, for zoonotic pathogens and for commensal bacteria (figure 1).

AMR relating to specific animal pathogens raises specific therapeutic difficulties for efficacy but without direct impact on human health for two reasons: (i) these pathogens (resistant or not) are not zoonotic; and (ii) the size of pathogenic microbiota is negligible when compared to the size of commensal microbiota. The latter is collaterally exposed to the AMD during therapy. Therefore, it is only indirectly that this first type of veterinary AMR may impact on human medicine by requiring the use of some second line drugs i.e. more critical antibiotics regarding serious infections in human medicine.

AMR of zoonotic food-borne pathogens, such as *Salmonella, Campylobacter* and some strains of *E. coli*, is potentially more serious. However, most cases of salmonellosis and campylobacteriosis in humans do not require AMD treatment; outbreaks of salmonellosis are decreasing thanks to the application of sanitary measures; most zoonotic salmonella and campylobacteriosis of EU/USA food-borne origin are susceptible to fluoroquinolones, third generation cephalosporins and macrolides (the latter for campylobacteriosis) and; resistance to a zoonotic pathogen is primarily an individual human issue and not an ecological hazard. Therefore, the impact of veterinary AMD usage on zoonotic food-borne pathogens is of limited importance.

Figure 1. The three classes of pathogens or bacteria that may be exposed during veterinary antimicrobial therapy

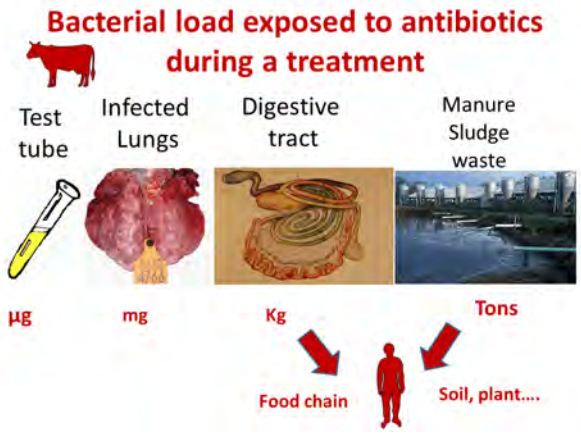


The hazard potentially associated with AMR of the animal's commensal microbiota of the GIT, and possibly of the skin also, is significant from an ecological perspective. These two large open bacterial ecosystems are potentially very significant due to their large biomasses. These outweigh considerably the biomass of specific or of zoonotic pathogens harboured by treated animals (figure 2). It is likely that the amplification of pre-existing or emerging genes of resistance display direct proportionality with microbiota size. For example, in a cow with pasteurellosis, the total lung pathogen load is at most a few mg, while the bacterial mass of the corresponding commensal microbiota harboured by the same animal is several kg i.e. a ratio of at least of 10^6. Consequently, the potential risk when treating a pulmonary infection is the exposure of the intestinal flora to the AMD (Kesteman *et al.*, 2010).

Moreover, the intestinal flora is regularly excreted at a high rate

into the environment by faecal emission, leading to spread of bacteria, including those harbouring genes of resistance, into the environment. For example, the annual emission of faeces by one sow and its litters is approximately 20 tons. This is by far the largest connection route of resistant bacteria and gene elimination between the animal and the human resistome.

Figure 2. Typical order of magnitude of bacterial masses exposed directly (lungs, g.i.t) or indirectly (sludge,…environment) to antibiotics by veterinary treatments

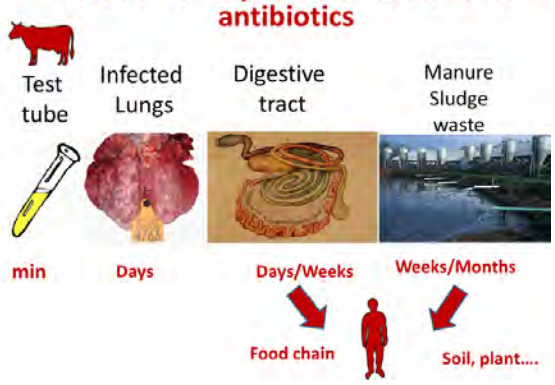


Even prior to any treatment of animals, the commensal microbiota may harbour genes of resistance (the so-called resistome) and the use of veterinary AMDs can promote the selection and amplification of this pool of genes, with the potential for transmission to man. If access is gained to the human g.i.t. microbiota, these bacteria can be viewed as a Trojan horse element. The potential is for transmission of their resistance genes to human commensal bacteria and then, through horizontal spread, to non-pathogenic human bacteria and also to some specific or opportunistic human pathogens causing nosocomial infections.

All currently used veterinary AMDs are able to alter the resistome of the GIT flora. In food producing animals, the most common route of AMD administration is oral. The most extensively used veterinary AMDs have low systemic bioavailability. Thus, the non-absorbed fraction exposes the caecum and colon, containing the densest bacterial population of the body; this non-absorbed AMD can develop its selective action during a period of 24–36h, before being eliminated in the faeces, and return to control conditions may require several weeks (Bibbal *et al*. After systemic administration (intramuscular, subcutaneous injection) most AMDs are eliminated by the digestive tract. AMDs excreted in faeces or urine can continue to develop their selective pressure on microbiota harboured by waste, sludge, manure… and beyond, in the matrices of the environment (water, soil). Some 70% of the AMDs administered to food producing animals are excreted as active substances into the environment; moreover, some AMDs are stable in the environment for weeks or months (figure 3).

Deriving from the above considerations, a green AMD should possess both pharmacokinetic (PK) and pharmacodynamic (PD) selectivity. First, it should distribute primarily to the locus of the targeted pathogen and second it should have no PD impact on commensal microbiota of the treated animal or on environmental ecosystems. Pharmacodynamic selectivity i.e. the use of only narrow spectrum antibiotics cannot solely nullify any veterinary contribution to human AMR, because commensal flora includes both gram positive and gram negative bacteria. The selectivity for minimal impact on public health extends to PK properties; distribution to commensal flora should be avoided.

Figure 3. Typical order of magnitude of duration of exposure of the different bacterial masses exposed directly (lungs, g.i.t) or indirectly (sludge,… environment) to antibiotics by veterinary treatments



In our opinion, it is possible to achieve such a goal not only by discovering new AMD classes but also by revisiting the currently available classes of veterinary AMDs (Ferran *et al*. 2011 and 2013). For oral dosing, a very high bioavailability will minimise any impact on the GIT flora. For parenteral administration, the development of new AMDs, screened to be mainly eliminated by renal clearance, is highly desirable to replace those currently used AMDs that are extensively eliminated in the GIT (bile or enterocyte efflux). In slurry and manure, many options exist to degrade excreted AMDs and active metabolites.

In conclusion, we advocate the introduction of green AMDs into veterinary medicine on public health grounds, arising from ecological considerations and not from any need to improve veterinary practices.

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Application of pharmacological principles to dosage design of antimicrobial drugs

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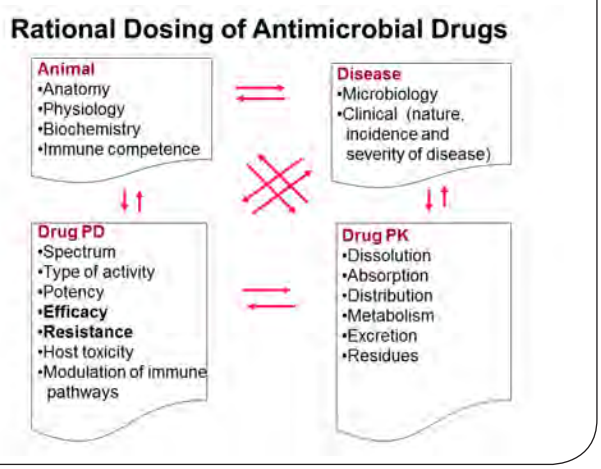
Pharmacokinetic/pharmacodynamic (PK/PD) integration and modelling of antimicrobial drugs (AMDs) provide the only rational approach to dosing schedule design for optimising bacteriological cure and minimising the emergence resistance (Figure 1).

Figure 1. Factors influencing dosage of antimicrobial drugs



The optimal dose depends on both PK and PD variables, as defined by the classical equation:

$$\text{Dose} = \frac{Cl \times AUC}{F} \quad \text{.....eq (1)}$$

where *Cl=clearance, F=bioavailability* and *AUC=area* under plasma concentration-time curve providing a high level of kill, ideally virtual eradication.

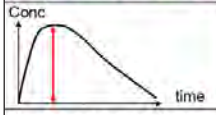
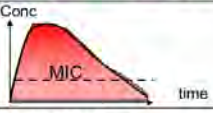
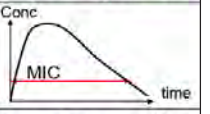
The PD measures of potency widely adopted for AMDs are Minimum Inhibitory Concentration (MIC), Minimum Bactericidal Concentration (MBC, a $3\log_{10}$ reduction in count) and Mutant Prevention Concentration (MPC, the concentration killing all organisms in a population containing sub-populations of higher MIC than the average).

To build PK/PD surrogates for AMD efficacy, three PK variables, C_{max} (maximum plasma concentration), AUC_{24h} (plasma AUC over 24h in steady-state conditions) and the time (T) during which plasma concentration exceeds MIC (as a percentage of 24h), have been integrated with MIC to provide three PK/PD indices: C_{max}/MIC, AUC_{24h}/MIC and T>MIC (Figure 2).

Selecting the most appropriate surrogate to best correlate with clinical outcome in patients is often oversimplified, as type of killing action is both "drug and bug" dependent; surrogates must therefore be established for each drug against each pathogen.

After selecting a PK/PD index predictive of efficacy, a numerical value to be targeted *in vivo* is determined. For AUC_{24h}/MIC, *in vitro* time-kill curves can be modelled with an E_{max} model to estimate the critical values (breakpoints) to achieve bacteriostatic, bactericidal or eradication responses. For example, based on 24h time-kill curves, using several multiples of MIC, the AUC_{24h}/MIC ratio versus bacterial count for the concentration-time relationship is determined (Figure 3). However, AUC_{24h}/MIC has particular utility, as the PK component encompasses both concentration and time.

Figure 2. Killing actions of antimicrobial drugs and PK/PD surrogates for efficacy and resistance

Concentration-dependent	Co-dependent	Time-dependent
C_{max}>MIC	AUC_{24h}/MIC ratio	T > MIC
Obj: Ratio > 10-12	Obj: Ratio > 125h	Obj:during 50-80%
		
Aminoglycosides Fluoroquinolones Metronidazole (vs. anaerobes) Polymixins	Tetracyclines Beta-lactams (for resistance) Fluoroquinolones *(vs. anaerobes)* New macrolides (tulathromycin)	Beta-lactams (for efficacy) Older macrolides Lincosamides Sulfonamides

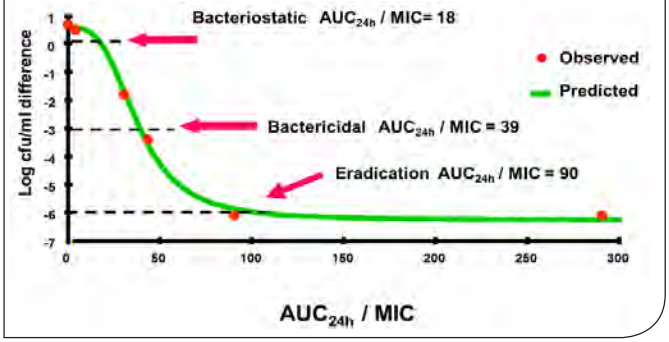
When T>MIC is selected, *a priori* values (e.g. T>MIC for 50 or 100% of dosage interval) are chosen. If AUC_{24h}/MIC is selected, its targeted breakpoint value, with plasma clearance and MIC distribution of the pathogen are applied to equation 2 to compute a daily maintenance dose at steady-state:

$$\text{Dose} = \frac{Cl \times PK/PD_{breakpoint} \times MIC}{f_u \times F} \quad \text{.....eq (2)}$$

where f_u is free drug fraction (0 to 1). The PK/PD breakpoint is an

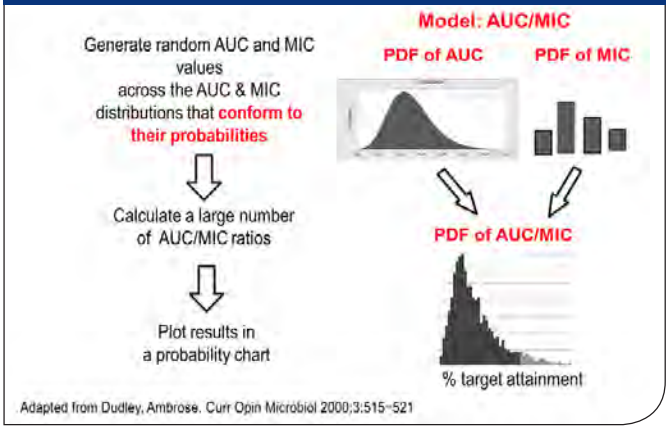
MIC scaling factor and to target a numerical value of e.g. 125h provides a dose achieving an average plasma concentration over 24h in steady-state equal to approximately five times MIC (actually 125h/24h) (Toutain *et al.*, 2007).

Figure 3. Sigmoidal E_{max} relationship for bacterial count versus ex vivo AUC_{24h}/MIC in goat serum (danofloxacin) and critical breakpoints



Equation 2 is solved using the known MIC and average values for plasma *Cl*, f_u and *F* to provide an "*average daily dose*" . However, the MIC is generally unknown. Moreover, in such empirical AMD therapy, it is necessary to guarantee that the dosage will be *a priori* efficacious for a majority (say 90%) of patients. Computing the distribution of *probable doses* is undertaken by using in equation 2 population distributions of the PK variables. If the MIC of the pathogen in a given patient is unknown, the MIC distribution is obtained from epidemiological surveys. Equation 2 is then solved using PK population parameters and MIC distributions reflecting epidemiological prevalence of the pathogen. Using Monte Carlo (MC) repeated random sampling computations, the population distribution of the daily doses is generated. This yields target attainment rate (TAR) dosages of 50, 90% or any quantile of the population for any level of kill, depending on the selected breakpoint value of the PK/PD index (Figure 4).

Figure 4. Monte Carlo computation of dosage : PDF=probability density function (adapted from Dudley et al., 2000)

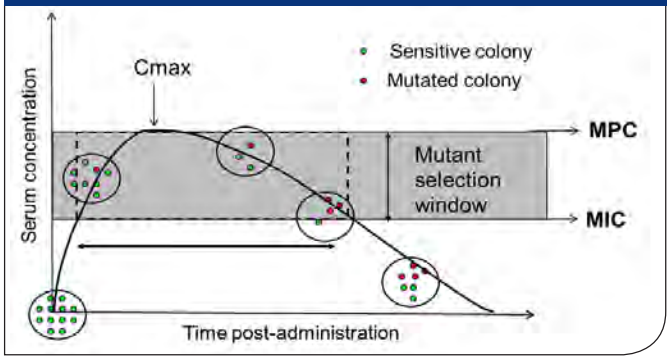


This approach does not use worst, best or average value for each input item but rather its full distribution *in proportion to its incidence*. A series of TARs is thus generated for the drug and each bacterial species. A refinement can be used to adapt this population dose (e.g. in critical care units) allowing use of personal PK parameters. It can also be adapted to determine TARs for an initial loading dose (when the initial drug concentration is zero), a 24h maintenance dose (when PK steady state has been achieved) or single dose therapy for products with a prolonged action duration. Furthermore, MC computations can be adapted to determine TARs for differing pathogen loads. For example, Jumbe *et al.* (2003) showed that an AUC_{24h}/MIC ratio of 31.2h provided a bactericidal action for a challenge of 10^6 colony forming units (cfu) whereas a challenge of 10^7 cfu required a ratio of 161.4h.

PK/PD approaches are also used to determine doses which minimize the emergence of resistance. However, the breakpoint values guaranteeing optimal efficacy may actually amplify resistant subpopulations. The difference from TARs calculated to provide a given level of kill (where the relationship is sigmoid, greater exposure yielding a higher response) is that for resistance avoidance the exposure-response relationship has the shape of an inverted "U". This delimits a range of exposures (and thus of doses) favouring the selection of less susceptible mutants. This plasma concentration range has been termed Mutant Selection Window (MSW) and is limited by two critical plasma concentrations: the MIC of the wild (initial) population and the MIC of the first-mutant sub-population, the Mutant Preventive Concentration (MPC, Figure 5). It is recommended that the dosage regimen should limit the time spent in the MSW.

The size and shape of the inverted "U" vary with number of organisms (pathogen load), immune competence (or not) of the host and duration of therapy. The longer therapy continues, the more difficult it generally becomes to suppress amplification of the more resistant sub-population; therefore the aim must be to hit the organisms hard and fast, with high dosage, short duration treatment of 4–5 in preference to 10–14 days (Mouton *et al.*, 2011). If bacteria in the biophase are significantly reduced by AMD action at the start of therapy with a high initial dose, immune mechanisms will likely suffice to achieve eradication (Tam *et al.*, 2007). By the same principle, it may generally be preferable, in respect of AMD use prophylactically for surgery, to provide a short course only or even single dose therapy.

Figure 5. Concentration (MPC) and selection of resistance (adapted from Drlica 2003)



There are two additional major but poorly recognized (or quietly ignored) issues relating to the application of PK/PD principles to dosage schedule design. (1) The internationally recognized methodologies and standards for MIC determination (e.g. CLSI, EUCAST) are based on doubling dilutions, so that the true MIC will almost always be over-estimated; thus if the measured MIC is 0.64µg/mL, the true value might be as low as 0.33µg/mL. (2) The artificial growth media used universally for MIC determination are formulated to facilitate growth, but they are usually far removed in composition from the biological fluids which comprise the biophase in systemic infections. To address these issues, we routinely determine MIC using five overlapping sets of doubling dilutions and in biological fluids such as serum. Differences between artificial growth media and serum may be profound. For the triamilide tulathromycin, MICs were some 50-fold lower in serum than in broth for calf pneumonia pathogens, whilst oxytetracycline MICs were approximately 25-fold higher in serum (Brentnall *et al.*, 2013).

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2. *Alain graduated from the National Veterinary School of Toulouse in 1988. He completed his PhD in pharmacology at the University of Toulouse in 1995 and became Diplomate of the European College of Veterinary Pharmacology & Toxicology (ECVPT) in 2001. He joined the staff of National Veterinary School of Toulouse in 1992, progressing from Assistant Professor to Professor. He is performing his research in veterinary pharmacology, with focus on pharmacokinetics, pharmacodynamics and modelling. He has supervised the studies of eight PhD students and has published more than 60 peer reviewed articles in this field. He currently leads a team working on veterinary antibiotics that explores the relations between antimicrobial dosage regimens and emergence of bacterial resistances. Alain is a member of the newly created Veterinary Committee on Antimicrobial Susceptibility Testing (VetCAST).*

3. *Aude is Assistant Professor of Physiology at the National Veterinary School of Toulouse, Aude Ferran received her Veterinary degree in 2007 and her PhD in Pharmacology in 2009. She has been Diplomate of the European College of Veterinary Pharmacology and Toxicology since 2012 and expert at the French Agency for Food Safety since 2014. Her principal research interests are the pharmacokinetics and pharmacodynamics of antibiotics and bacterial resistance to antimicrobial drugs. Aude is developing projects aiming at proposing innovative drug dosage regimens for antibiotics in veterinary species which preserve animal and human health.*

4. *Ludovic graduated from the École Nationale Vétérinaire d'Alfort (Paris, France) in 2001. Ludovic completed his pharmacology PhD at RVC in 2010 on the roles of cyclooxygenase (COX) isoenzymes in the regulation of inflammation and renal function in the cat. Ludovic gained the European Diploma in Veterinary Pharmacology and Toxicology in 2014. He is currently employed at RVC as a lecturer in clinical pharmacology and anaesthesia. His research interests are pharmacology of analgesics and antimicrobials in veterinary species. He is developing research programs in pharmacokinetics, mathematical modelling (PK-PD) and population pharmacokinetics in veterinary species. Ludovic is striving to expand the bioanalytical laboratory and is coordinating the RVC therapeutic drug monitoring service. He is a member of the newly created Veterinary Committee on Antimicrobial Susceptibility Testing (VetCAST), the EUCAST subcommittee dealing with antimicrobial susceptibility testing of bacterial pathogens of animal origin and animal bacteria with zoonotic potential.*

5. *Peter qualified in Pharmacy (London University) in 1961 and completed his PhD at the Royal Veterinary College in 1965. He joined the staff of RVC in 1964, progressing from Assistant Lecturer to Vice-Principal for Teaching, Deputy Principal and, more recently, failed retiree. He has supervised the studies of 24 PhD students and has published more than 300 peer reviewed articles on the pharmacokinetics and pharmacodynamics of non-steroidal anti-inflammatory and antimicrobial drugs in species of veterinary interest, from cat to pig to horse. He is a recipient of the Lloyd Davis Award. Peter is a member of the newly created Veterinary Committee on Antimicrobial Susceptibility Testing (VetCAST).*

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Open to individuals having a professional interest in pharmacology or a closely related subject who do not have the necessary qualifications to become Members.

Standard Tariff - £70

Postgraduate Member

Open to individuals studying for higher degrees in pharmacology, or closely related subjects. Also open to clinicians in training who have a specific interest, or intend to follow a career in clinical pharmacology.

Standard Tariff - £20

Undergraduate Member

Open to individuals studying for degrees in pharmacology and other undergraduates whose courses include a substantial pharmacology component. Also open to medical students at any stage of training.

Standard Tariff - Free

Benefits

Free or discounted rates at our scientific meetings.

Keeping up-to-date with developments in pharmacology by networking with the Society's >3,500 members worldwide: at special networking events hosted by the Society or online at services.bps.ac.uk/Home/Find-a-member.

Free access to the *British Journal of Pharmacology* and *British Journal of Clinical Pharmacology* including articles accessed through the iPhone/iPad app for each journal

Becoming eligible to apply for bursaries to attend scientific meetings. The Society aims to give financial support to all eligible applicants and give out £50,000 in travel awards each year.

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Membership & Awards Officer
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E-mail: membership@bps.ac.uk

Antibiotic Resistance Collection

Portland Press publishes papers relevant to the study of antibiotics and resistance

To coincide with the latest issue of *The Biochemist* on antibiotic resistance, we have put together a collection of papers related to this topic.

Heatley Medal Lecture: Understanding and manipulating antibiotic production in actinomycetes
Mervyn J. Bibb
Biochemical Society Transactions (2013)

The regulatory role of Streptomyces coelicolor TamR in central metabolism
Hao Huang, Smitha Sivapragasam and Anne Grove
Biochemical Journal (2015) 466, 347-358; doi:10.1042/BJ20130838

Nanomechanics of superbugs and superdrugs: new frontiers in nanomedicine
Rachel A. McKendry
Biochemical Society Transactions (2012)

Hydrogenase: the next antibiotic target?
Wei Nie, Hao Tang, Zheng Fang, Jiquan Chen, Haili Chen and Qingyu Xiu
Clinical Science (2012)

How Bugs Kill Bugs: progress and challenges in bacteriocin research
Biochemical Society Transactions (2012)

Browse the collection here

www.biochemj.org/bj/subjects/collections

Submit your next paper to one of our journals
www.portlandpress.com/pp/profile.htm?who=Author

BIOCHEMICAL SOCIETY

PORTLAND PRESS

DAP | Diploma in Advanced Pharmacology

Who is eligible?

The Diploma is a Masters level programme, open to both BPS members and non-members. Diploma students will receive Associate Diploma Student membership of the Society, which is free for the first year. Students should normally be working at the time of application and have suitable data to present as part of their Diploma.

What is the Diploma?

The BPS Diploma in Advanced Pharmacology has been developed and is run by experts from academia, industry and healthcare, and is intended to provide an advanced pharmacological education alongside normal employee duties for researchers who are new to the field of pharmacology, or who wish to develop their expertise further.

Participation in the Diploma programme will:

- Broaden and deepen pharmacological knowledge and skills
- Offer career development opportunities
- Involve interaction with cutting edge researchers
- Provide networking opportunities with a range of scientists in industry, academia and healthcare
- Develop transferable skills such as oral communication skills, presentation skills and written communication skills

What is involved?

Attendance at six core and specialist workshops
Oral and poster communications at BPS meetings
A 6,000—7,000 word dissertation

Costs and registration

The cost of registering for the Diploma is £200, plus fees for the six workshops. For further details including how to apply please visit bit.ly/1cnlUS3 or contact Becca Tibbs at rebecca.tibbs@bps.ac.uk

The Diploma has been a great experience and one of the most worthwhile things I have done
David Winpenny, BPS Diploma graduate 2010

The Diploma helped me develop my presenting skills, gave me an opportunity to network and just helped me remember how to learn!
Dr Laurice Fretwell, BPS Diploma graduate 2012

BPS | BRITISH PHARMACOLOGICAL SOCIETY

Today's science, tomorrow's medicines

BPS BRITISH PHARMACOLOGICAL SOCIETY
Today's science, tomorrow's medicines

bts driving excellence in toxicology

Stratified medicine & prevention of adverse drug reactions

A joint meeting of the British Toxicology Society & the British Pharmacological Society
5—6 October 2015, Royal College of Physicians of Edinburgh, UK

This meeting will focus on how the concept of stratified medicine may prevent adverse outcomes for the patient. The programme will cover all aspects from the basic mechanisms through pharmacology and toxicology model systems to clinical pharmacology and all the way to the use in practice and finally to the regulatory perspective.

Co-Chairs:
Professor Heather Wallace, President of the British Toxicology Society
Professor David Webb, President-Elect of the British Pharmacological Society

Session 1: An overview and introduction to the problem in relation to public health
Session 2: Basic mechanisms, clinical pharmacology and toxicology, genetics, immune system
Session 3: Basic pharmacology and toxicology / animal models
Session 4: How to apply the knowledge in practice

Confirmed Speakers:
Dr Graham Cooke, Imperial College London, UK
Dr James Dear, University of Edinburgh, UK
Dr Colin Henderson, University of Dundee, UK
Professor Magnus Ingelman-Sundberg, Karolinska Institutet, Stockholm, Sweden
Dr Phil Jeffrey, Pfizer Ltd, UK
Professor Duncan Jodrell, University of Cambridge, UK
Professor David Juurlink, University of Toronto, Canada
Dr Dean Naisbitt, University of Liverpool, UK
Professor Kevin Park, University of Liverpool, UK
Professor Munir Pirmohamed, University of Liverpool, UK
Dr Krishna Prasad, MHRA, UK
Dr Angela Thomas, CHM, University of Edinburgh, UK
Professor Jack Uetrecht, University of Toronto, Canada
Dr Dominic Williams, AstraZeneca, UK

For more information or to register please contact:
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