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CRISPR SYSTEMS

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A little too late?

One of my favourite singers is Australia's sweetheart, Delta Goodrem, who was meant to be on tour this year to promote her new album. Sadly, there has been a very different Delta making its way around the country lately — particularly in Greater Sydney, where I live — providing a timely reminder that the threat of COVID-19 is still very real and very serious. We are also now back at the stage where new health advice is seemingly being announced, updated or flat-out reversed every few days, which is not ideal for a bimonthly print publication.

So, since I wrote my last editor's comment, the Australian Technical Advisory Group on Immunisation (ATAGI) has 'unrecommended' the AstraZeneca vaccine for those between ages 50 and 59, re-recommended it to all adults in the Greater Sydney region owing to the current outbreak (several weeks after Prime Minister Scott Morrison introduced an indemnity scheme for GPs who administer the vaccine to younger people), and even recommended shortening the gap between doses in outbreak situations from as long as 12 weeks to as short as four. Meanwhile, delivery of Pfizer vaccines has finally been ramped up to one million doses a week; the vaccine has been provisionally approved for children as young as 12 years of age; pregnant women have finally been added to the Phase 1b priority group; and the time between doses may actually be extended from three to six weeks, in order to maximise first-dose protection in outbreak areas. Here's hoping that these measures will have some effectiveness at quashing the current outbreak, and that next issue I will be writing to you under happier circumstances.

Of course COVID isn't the only disease in need of a vaccine, and I was fascinated by the recent news that Japanese scientists are currently developing a new vaccine to protect against deadly cholera — made from ground-up grains of rice. The vaccine candidate grows in genetically modified Japanese short-grain rice plants that produce a nontoxic portion of cholera toxin B (CTB) that can be recognised by the immune system; when the plants are mature, the rice is harvested, ground into a fine powder, mixed with about 90 mL of liquid and then drunk. The vaccine is said to be stable at room temperature from start to finish, with the first human trial showing no obvious side effects and a good immune response. If only COVID vaccine manufacturing were that easy!

Elsewhere in the world of immunology, US researchers have announced a way to boost the immune system to fight antibiotic-resistant bacterial infections — an accidental discovery that could be on par with the birth of penicillin (see our coverage on page 31). You can also read on page 17 about the discovery of egocentric spatial brain cells in humans, which apparently help us centre ourselves in our personal maps of the world (considering how terrible I am at navigation, I do rather suspect I'm missing a few of these!). And on page 34, we have a handy little explainer about linearity in the weighing industry and what it's all about.

As we wait for this latest wave of COVID to blow over, it's easy to feel paralysed, disorientated and a little fragile. It seems so long ago that we were hit with this virus out of the blue, and sometimes it feels like it's a little too late to turn things around. But vaccines have given us a way to take back control, individually and through herd immunity, so that together we are one. So hold on, be strong and put your brave face on.

Regards,
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Cas9 alternatives

empower next-gen CRISPR applications

Recent CRISPR discoveries include many new cutting enzymes, widening the scope of DNA engineering. Twist Bioscience reviews the new enzymes in-depth here.

Less than a decade after the debut of CRISPR-Cas9 as a genomic scissor, the question "what can Cas9 do?" has become difficult to answer. After all, what can't Cas9 do? Remove its nuclease activity, and Cas9 becomes a modular platform for transcriptional control, epigenetic modification, genomic labelling and base editing, among other applications. The tremendous biotechnological success of Cas9 has spurred efforts to expand the CRISPR toolbox to include other CRISPR nucleases, empowering the next generation of CRISPR applications.

CRISPR-associated (Cas) enzymes exist in most archaea and many bacteria as a component of their adaptive immunity. In 2015 — only a couple of years after Cas9 was first repurposed as a gene editor — Cas systems were organised into two classes, five types and 16 subtypes based on their distinguishing features. Today, the classification system includes two classes, six types and 33 subtypes[12]. This change was driven partly by the pursuit of new class 2 systems that could be repurposed for genome engineering à la Cas9. These include the DNA editor Cas12a (Cpf1) and Cas13-based RNA editors.

Although Cas9 is the gold standard for single-knockout screening applications, its application in combinatorial screens has been hamstrung by its suboptimal multiplexing capabilities.

Argonautes, a group of nucleic acid-guided proteins mostly distinct from CRISPR-Cas systems, received bad press in 2016 when a high-profile paper was retracted after several independent groups failed to replicate claims of their so-called gene editing capabilities[5]. Nevertheless, Argonautes warrant mention here, if only to point out an application for which they are better suited than CRISPR systems.

Here we highlight a few of the most transformative developments in CRISPR (and Argonaute) technology compiled by Twist Bioscience's experts.

Cas12 simplifies combinatorial screens

Many biological processes such as tumour metastasis involve complex genetic interactions that cannot be fully resolved using a single-knockout approach. Although Cas9 is the gold standard for single-knockout screening applications, its application in combinatorial screens has been hamstrung by its suboptimal multiplexing capabilities. Multiple independent groups recently optimised the type V CRISPR system Cas12a (Cpf1) to provide an improved alternative to Cas9 for combinatorial gene editing at scale[3,6].

What makes Cas12a better than Cas9 for combinatorial screens? Cas12a can process arrays of CRISPR RNAs (crRNAs) without RNase III and a trans-activating RNA (tracrRNA), components that are required for Cas9 to accomplish the same task. Because Cas9 cannot process crRNA arrays by itself, Cas9 guides typically must be expressed in separate expression cassettes, one per guide. The repetitive elements in multiplexed Cas9 guides make them prone to recombination and uncoupling during lentiviral delivery, PCR and deep sequencing. These factors can complicate library design, cloning and analysis.

With Cas12a, oligos containing multiple crRNAs can be synthesised and easily cloned into lentiviral vectors for combinatorial screening applications. Moreover, the repetitive elements in multiplexed Cas12a guide vectors are comparatively short and more tolerant of sequence modifications, making multiplexed Cas12a guides less vulnerable to recombination and uncoupling throughout the screening process[3,6]. A 300mer oligo from Twist Bioscience can encode 3–4 guides simultaneously.

While Cas12a is a great multiplexer, some of its limitations include a more restrictive protospacer adjacent motif (PAM) specificity (5'-TTTV) and lower mutation efficiency relative to Cas9. These parameters have been improved through structure-guided protein engineering of Cas12a from Acidaminococcus (AsCas12a[9]), culminating in a modified enzyme named enhanced AsCas12a (enAsCas12a) that contains multiple point mutations in residues important for PAM recognition. In addition to expanding its PAM specificity (now including TTYN, VTTV and TRTV, among others), enAsCas12a was serendipitously found to improve editing efficiency twofold on average compared to AsCas12a. AsCas12a's efficiency has been further improved by adding multiple nuclear localisation sequences and clarifying on- and off-target crRNA rules[3,6].

Type VI CRISPR systems set their sights on RNA

RNA interference (RNAi) using short-hairpin RNAs (shRNAs) is a well-established gene knockdown

strategy that co-opts an endogenous RNA processing pathway to degrade cellular mRNAs. However, RNAi suffers from off-target effects and inconsistent knockdown efficiency. The specificity problem has been solved with CRISPR interference, a knockdown approach that uses a nuclease-dead Cas9 fused to the transcriptional repressor domain KRAB. Even so, both CRISPR interference and RNAi occasionally fail to robustly knock down their targets in cases of high basal gene expression or poor shRNA hairpin processing, respectively.

Enter RfxCas13d (CasRx), an RNA-guided, RNA-targeting CRISPR nuclease. CasRx may not have been the first RNA editor discovered, but side-by-side comparisons with other Cas13 systems (LwaCas13a and PspCas13b) and existing methods demonstrate that CasRx induces the most substantial knockdown across many genes — and with high specificity to boot. What's more, a nuclease-dead variant dCasRx can be targeted to cis-elements of pre-mRNAs to regulate their splicing. To highlight this feature, Konermann et al[10] targeted dCasRx to an intronic splice silencer to rectify the pathological splicing of Tau-encoding mRNA in a neuronal model of frontotemporal dementia.

Because they prefer single-stranded RNA, the targeting of Cas13 systems in general can be hampered by RNA secondary structure[1]. However, their ability to cause transient changes by targeting RNA over the genome, and their lack of sequence constraints, makes them attractive transcriptome editing tools for both experimental and therapeutic applications.

Class 1 CRISPR-Cas systems diversify the CRISPR toolkit

As class 2 CRISPR-Cas systems such as Cas9, Cas12s and Cas13s continue to dominate the genome engineering space, class 1 CRISPR-Cas systems are beginning to garner attention because of their unique cleavage properties and multi-protein composition. The most common among these are type I systems, which combine the Cas3 helicase with a complex of accessory Cas proteins called CRISPR-associated complex for antiviral defence, or 'Cascade'.

If Cas9 and Cas12a are genomic scissors, then Cas3 is a genomic shredder. Rather than producing small indels like Cas9, Cas3 causes a spectrum of large genomic deletions — ranging from 0.5 to 100 kb in length — upstream of targeted genomic sites[4]. This feature promises novel high-throughput screening applications whereby libraries of deletion mutants can be generated with comparatively fewer guides than class 2 CRISPR systems.

The Cascade complex alone also provides a modular platform for RNA-guided transcriptional activation and repression. Site-directed repression can be achieved using crRNAs in *cas3*-deleted *E. coli*[11,14] or in mammalian cells expressing exogenous Cascade proteins[2,13].

For gene activation, transcriptional activator domains need to be fused to one or more members of Cascade. Chen et al[2] obtained the best results when the synthetic VPR (VP64-p65-Rta) activator domain was fused to Csy3, the backbone component of *Pseudomonas aeruginosa* Cascade (PaeCascade) that interacts with the crRNA. Because multiple Csy3 proteins participate in the formation of the PaeCascade complex, multiple transcriptional effector domains can be recruited to a single Cascade complex. This strategy does not necessarily work for other class 1 systems, however, as the fusion of transcriptional effectors to Cas7 of EcoCascade (its Csy3 equivalent) failed to elevate transcription at targeted loci[13].

The multi-protein nature of Cascade comes in handy for building modular devices for transcriptional control, but it also means that multiple effector proteins must be co-expressed. This could impede the use of class 1 systems for some applications.

Strange CRISPR loci reveal CRISPR-associated transposases

Most CRISPR loci contain genes for site-directed nucleases. For example, CRISPR loci encoding type I systems typically contain *cas3*, which encodes the endonuclease effector of these Cas systems. Recent bioinformatic analyses, however, revealed CRISPR loci containing Tn7-like transposon genes instead of Cas endonuclease genes. From these loci, two CRISPR-associated transposon systems have been characterised: the class 2 type V-K effector Cas12k[15] and the class 1 type I-F Cascade complex[8]. Instead of cleaving DNA, these Cas systems can insert large segments of DNA into the genome in a site-directed and nuclease-independent fashion.

Traditional CRISPR-based gene knock-in approaches depend on homology-directed repair following a site-directed DNA break — a very >

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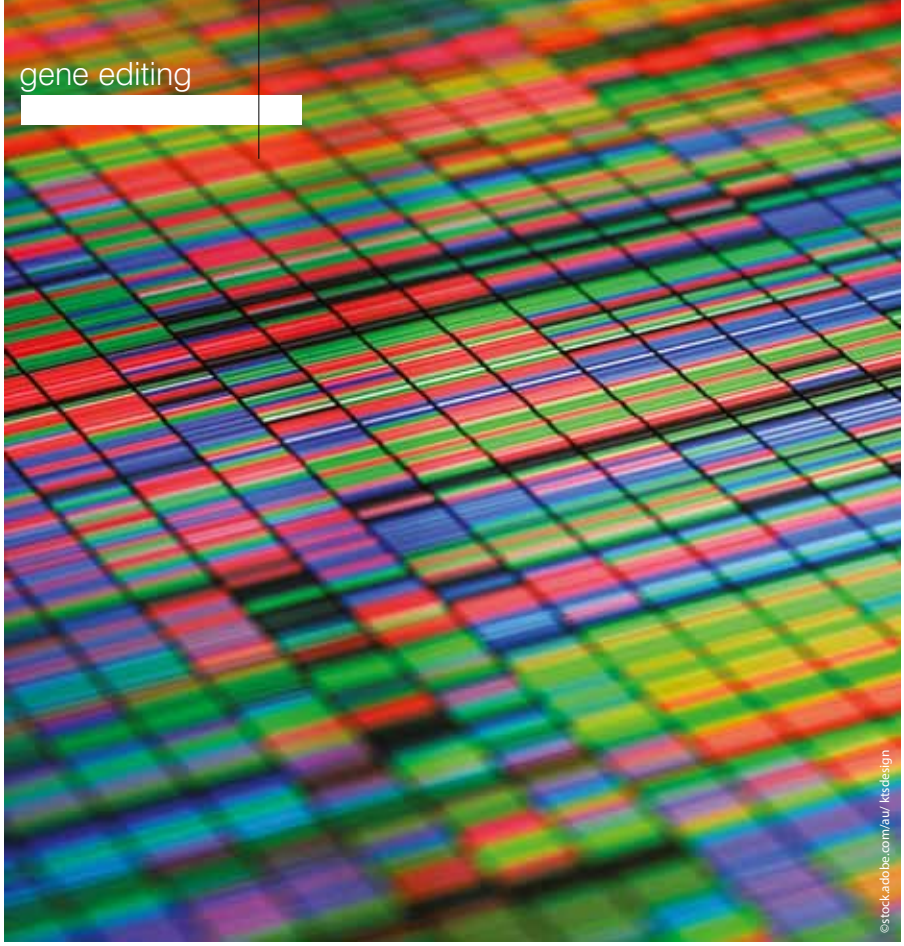

inefficient process. The newly identified CRISPR-associated transposons offer a potentially more efficient workaround by allowing the transposition of large DNA fragments. CRISPR-associated transposases could be used to replace faulty exons or generate chimeric antigen receptor (CAR) T cells. While promising, the transposase activities of these systems have not yet been demonstrated in eukaryotic cells.

Argonautes facilitate DNA data storage

Sometimes the best alternative to Cas9 is not a CRISPR system at all. This is true for nick-based DNA data storage, which requires a nicking enzyme to encode information in native DNA. DNA has been proposed as an alternative to current silicon-based storage media because of its relatively high durability and enormous storage density. To further push the limits of the information storage density of DNA, researchers have recently developed a nick-based approach[16].

Tabatabaei et al[16] leveraged the favourable nicking properties of PfArgo to create a DNA writing device that turns a dsDNA strand into a 'punch card'. Here, binary information is encoded positionally in a pattern of nicks, which can be read by denaturing the DNA single-stranded fragments. These fragments can then be sequenced by next-generation or nanopore sequencing and mapped to the reference punch cards to retrieve the encoded information. Highlighting the outstanding storage density of this strategy, Tabatabaei et al compressed a 329 KB JPEG of the Lincoln Memorial into a 14 KB DNA file!

For nick-based DNA data storage, Cas9 nickase's nicking properties pale in comparison to those of *Pyrococcus furiosus* Argonaute (PfAgo). Whereas the former is a single-turnover enzyme that relies on unstable and PAM-restricted RNA–DNA interactions for targeting, the latter can induce hundreds of nicks per enzyme using short DNA guides that are not limited by any specific targeting sequence.

These are just a few of the applications made possible by nucleic acid-guided proteins in the CRISPR and Argonaute families. To learn more about how to expand your CRISPR toolbox, contact Twist Bioscience.

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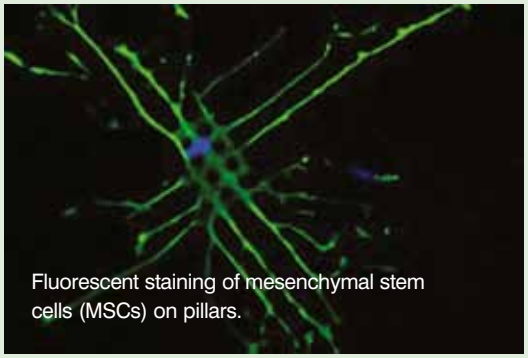
Researchers 'trick' stem cells into becoming bone

An international research team led by Monash University has found a way to alter the shape and nucleus of individual stem cells, which could speed up recovery following bone replacements. The research collaboration developed micropillar arrays using UV nanoimprint lithography that essentially 'trick' the cells into becoming bone. Their findings have been published in *Advanced Science*.



Fluorescent staining of mesenchymal stem cells (MSCs) on pillars.

Nanoimprint lithography allows low-cost, high-throughput and high-resolution microscale patterns to be created. When implanted into the body as part of a bone replacement procedure, such as a hip or knee, researchers found these pillars — which are 10 times smaller than the width of a human hair — changed the shape, nucleus and genetic material inside stem cells.

The team defined the topography of the pillar sizes and the effects it had on stem cells, discovering that four times as much bone could be produced compared with current methods.

"What this means is, with further testing, we can speed up the process of locking bone replacements with surrounding tissue, in addition to reducing the risks of infection," said Associate Professor Jessica Frith, from Monash University's Department of Materials Science and Engineering.

"We've also been able to determine what form these pillar structures take and what size they need to be in order to facilitate the changes to each stem cell, and select one that works best for the application."

Researchers are now advancing this study into animal model testing to see how they perform on medical implants.

Engineers, scientists and medical professionals have known for some time that cells can take complex mechanical cues from the microenvironment, which in turn influences their development. However, Dr Victor Cadarso from Monash University's Department of Mechanical and Aerospace Engineering says their results point to a previously undefined mechanism where 'mechanotransductory signalling' can be harnessed using microtopographies for future clinical settings. "Harnessing surface microtopography instead of biological factor supplementation to direct cell fate has far-reaching ramifications for smart cell cultureware in stem cell technologies and cell therapy, as well as for the design of smart implant materials with enhanced osteo-inductive capacity," Dr Cadarso said.

Professor Nicolas Voelcker from the Monash Institute of Pharmaceutical Sciences, who is also Director of the Melbourne Centre for Nanofabrication, said the study results confirm that micropillars not only impact the overall nuclear shape, but also change the contents of the nucleus. "The ability to control the degree of deformation of the nucleus by specifying the architecture of the underlying substrate may open new opportunities to regulate gene expression and subsequent cell fate," Prof Voelcker said.

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Blood test could help diagnose frontotemporal dementia

Finnish researchers have shown that blood-based measurement of glial fibrillary acidic protein (GFAP) can distinguish patients with frontotemporal dementia from those with primary psychiatric disorders or healthy individuals. The results of their study, published in the *Journal of Neurology, Neurosurgery and Psychiatry*, are expected to provide new tools for improved frontotemporal dementia diagnostics.

Frontotemporal dementia is the second most common cause of dementia in the working-age population. Its diagnostics are complicated by the similar symptoms presented by patients with psychiatric disorders or other neurodegenerative diseases, as well as the lack of reliable diagnostic tools for differentiating these patients from each other.

A research team led by the University of Eastern Finland has now shown that levels of GFAP are significantly higher in the blood of the frontotemporal dementia patients as compared to psychiatric patients or healthy individuals. Moreover, elevated blood levels of GFAP predicted enhanced brain atrophy and faster disease progression in frontotemporal dementia patients in the follow-up. GFAP originates from the glial cells in the central nervous system, and its increased levels reflect brain atrophy and neuroinflammation. Brain-derived biomarkers are currently mainly measured from the cerebrospinal fluid (CSF) of the patients.

However, the new study now indicates that ultrasensitive single molecule array (SIMOA) is a method that allows reliable detection of GFAP also from blood samples. This is much more practical and convenient for the patients and the healthcare system because it reduces the need for CSF sampling and allows wider use of biomarker measurements in clinical work. The new study also indicated that while GFAP shows good diagnostic performance on its own, its diagnostic accuracy is further increased when combined with blood-based measurements of the neurofilament light protein from the same patients.

In the future, it may be possible to distinguish patients with a neurodegenerative disease from patients with other brain diseases even at the onset of the first symptoms. This would enable intervention and support for the patients and their families at the earliest time possible.

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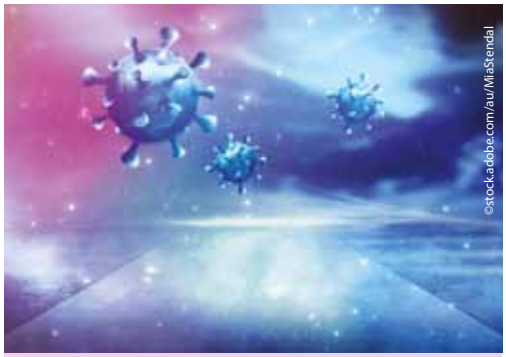


CRISPR stops SARS-CoV-2 from replicating in human cells

Scientists from Melbourne's Peter Doherty Institute for Infection and Immunity (Doherty Institute) and Peter MacCallum Cancer Centre (Peter Mac) have found a way to stop the SARS-CoV-2 virus from replicating in infected human cells, in a major step towards a new treatment for this and future pandemic viruses.

Published in the journal *Nature Communications*, the discovery builds on research that started at Peter Mac in 2019, when Dr Mohamed Fareh and Professor Joe Trapani showed a CRISPR gene editing tool could be used to eliminate abnormal RNAs that drive children's cancers. In collaboration with Director Professor Sharon Lewin and Dr Wei Zhao from the Doherty Institute, this same approach has been shown to suppress replication of the RNA virus SARS-CoV-2 — as well as its variants of concern — in a test tube model.

At the core of the tool is an enzyme (CRISPR-Cas13b) that binds to target RNAs and degrades part of the virus's genome needed to replicate inside cells. According to Prof Lewin, "The flexibility of CRISPR-Cas13 — which only needs the viral sequence — means we can look to rapidly design antivirals for COVID-19 and any new emerging viruses."

Dr Fareh said there were signs this approach — which the team will now move to test in animal studies — could also be applied to a host of existing viruses and be a game changer for how they are currently treated.

"Unlike conventional antiviral drugs, the power of this tool lies in its design flexibility and adaptability, which make it a suitable drug against a multitude of pathogenic viruses including influenza, Ebola and possibly HIV," Dr Fareh said.

Promising drug target for aggressive prostate cancer

Researchers at Cleveland Clinic, led by Dr Nima Sharifi, have identified a promising drug target for treating and preventing aggressive, drug-resistant prostate cancer. Their findings have been published in the journal *Science Translational Medicine*.

Enzalutamide, a current standard-of-care hormone therapy for metastatic prostate cancer, works by blocking androgen receptors, which are proteins that help drive cancer cells. While initially effective, most patients eventually develop resistance to the treatment. This resistance occurs when androgen receptors are blocked and cancer cells adapt to get their 'fuel' from a similar receptor, called the glucocorticoid receptor. These glucocorticoid receptors bind to and interact with the stress hormone cortisol.

In an earlier study, published in *eLife*, Dr Sharifi and his team linked enzalutamide resistance to increased tumour cortisol levels. They found that tumours typically express a protein called 11β-HSD2, which inactivates cortisol. However, when this protein expression is inhibited in some tumours, cortisol and the glucocorticoid receptor are stimulated and become available for use by cancer cells.

In their new study, the researchers demonstrated that, in addition to decreased expression of 11β-HSD2, resistant tumours also have increased levels of the protein H6PD. As noted by study co-author Dr Eric Klein, Chair of Cleveland Clinic's Urology & Kidney Institute, "We found elevated levels of H6PD in both animal models and patient tissues, particularly after treating tumours with enzalutamide."

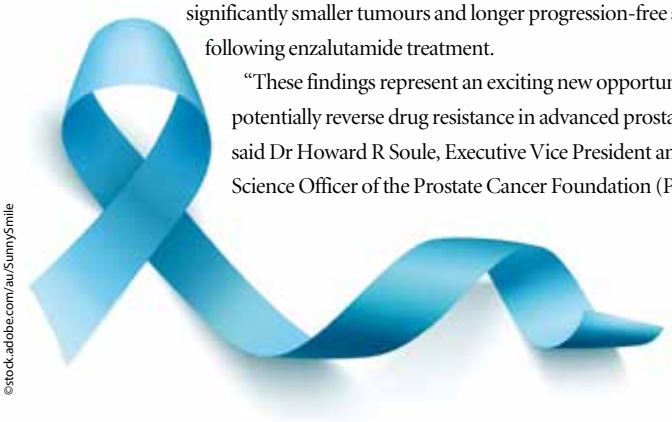
Inhibiting H6PD subsequently led to significantly reduced tumour sizes and improved survival among mouse models with drug-resistant prostate cancer. According to Dr Sharifi, who is also the Director of Cleveland Clinic's Genitourinary Malignancies Research Center, "Our study findings suggest that pharmacologically inhibiting the H6PD protein can reverse drug resistance in prostate cancer cells.

"By blocking this protein, we are able to prevent cancer cells from utilising their backup fuel supply — cortisol and its receptor. When we block this pathway, tumours begin to become responsive to standard treatments again.

"With lower levels of 11β-HSD2, which normally functions to cut off the fuel supply to drug-resistant cancer cells, the cells are free to continue to grow and spread unchecked. By inhibiting the H6PD protein, however, we were able to reinstate anti-cortisol effects. This finding is key to better understanding how disruptions in cortisol metabolism contribute to cancer cells' growth and spread."

The researchers targeted H6PD with rucaparib, a drug already approved by the US Food and Drug Administration. Researchers administered enzalutamide to mouse models of aggressive prostate cancer that expressed H6PD and those where the protein was blocked with rucaparib. The models where H6PD was blocked had significantly smaller tumours and longer progression-free survival following enzalutamide treatment.

"These findings represent an exciting new opportunity to potentially reverse drug resistance in advanced prostate cancer," said Dr Howard R Soule, Executive Vice President and Chief Science Officer of the Prostate Cancer Foundation (PCF).



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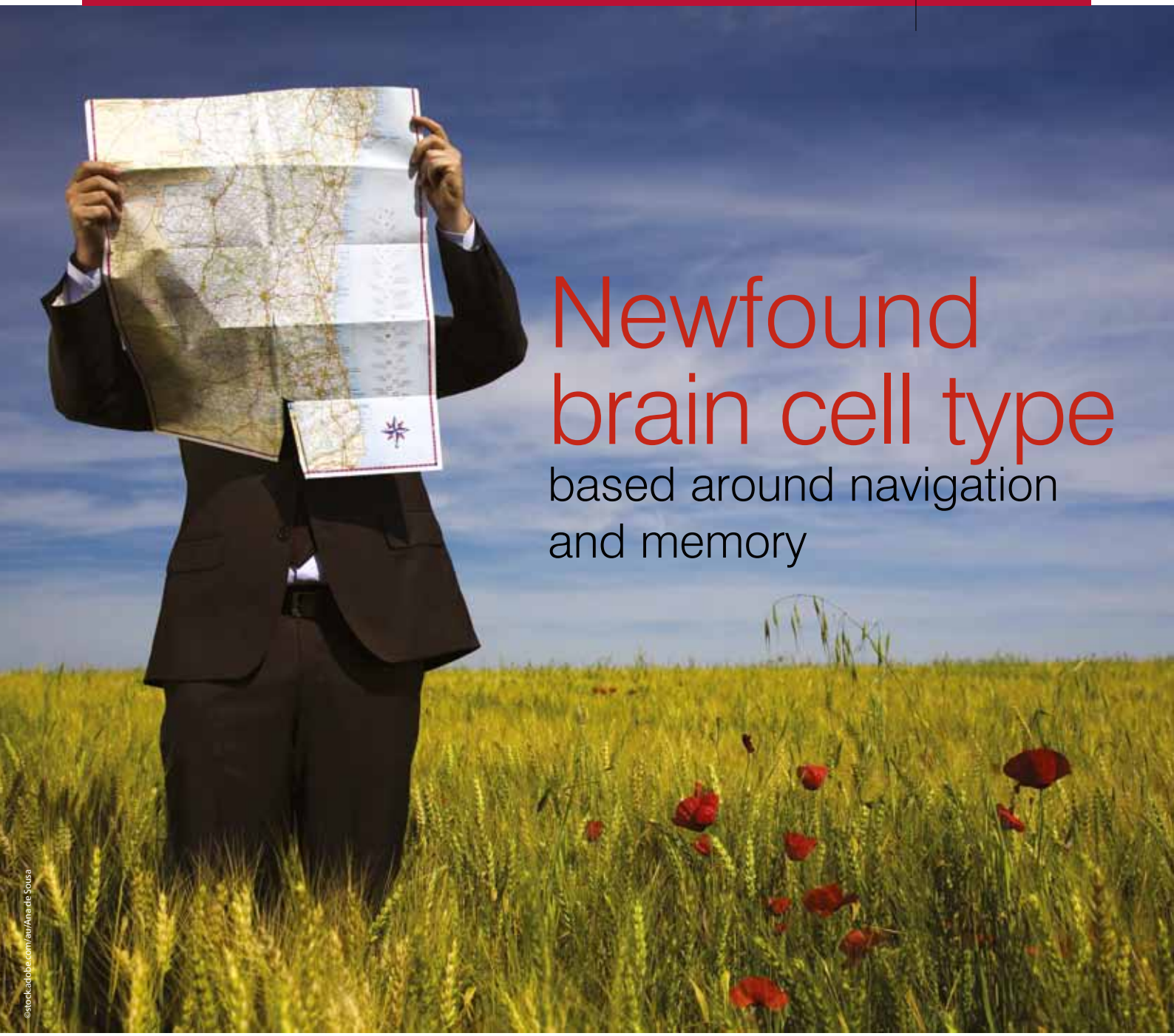
With an ergonomic electronic lock design, the centrifuge lid can be closed with a single finger touch. The rotor is meanwhile hermetically sealed by three rubber seals. Rotors are seated on a tapered shaft, concentric and self-aligning, to achieve running stability at high speeds.

Other features include a rotor imbalance detection alarm function, rotation speed/RCF switchover, inching operation, running process indicator and sound alert. There is storage capacity for up to nine programs according to experimental needs. The device is CE certified.

The refrigerated option, the DH.CEFM0024R, offers a powerful cooling system that is designed for precise temperature control. Its pre-cooling program enables optimal protection of the sample before warming. 2°C cooling is achieved within only 7 min for both chamber and samples, even at max speed, while the lid lock facility allows for internal temperature maintenance even after centrifugation. The product has CFC-free refrigerant, low carbon and environmental protection, and an external condensation tank prevents water accumulation within the centrifuge chamber.

Pacific Laboratory Products
www.pacificlab.com.au



Newfound brain cell type

based around navigation and memory

A previously unknown kind of human brain cell appears to help people centre themselves in their personal maps of the world, according to a new study from US and German neuroscientists.

Their discovery sheds light on the cellular mechanisms underlying navigation and memory in humans, as well as what parts of the brain might get disrupted during the kinds of memory impairments common in neurodegenerative diseases such as Alzheimer's. It has been published in the journal *Neuron*.

There are two strategies with which humans and animals navigate and orient themselves. One involves locating places, distances and directions in 'allocentric' or other-centred frames of reference rooted in the external world. The other strategy involves 'egocentric' frames of reference that are centred on the self.

Whenever you use a mobile phone app to find driving directions, it will likely employ both these modes of navigation. When you first type in an address, it will normally show you the address on a map from an allocentric perspective, with north at the top and south at the bottom. When you then go to route view, it will switch to an egocentric perspective where 'ahead' is at the top and 'behind' is at the bottom.

Scientists first discovered brain cells linked with allocentric frames of reference in rats in 1971 — 'place cells' that may, for example, indicate that one is located in the north-east corner of an area. Other allocentric spatial cell types include head-direction cells that may activate whenever one is navigating south, or border cells that may respond when a boundary is located to the west.

In the past decade, researchers began investigating how rat brains mapped egocentric frames of reference. Two years ago, scientists at Dartmouth College in the US identified a brain region in rats called the postrhinal cortex in which egocentrically tuned cells are abundant. However, it remained poorly understood what brain cells formed the basis of egocentric spatial maps in humans.

"In humans it is only rarely possible to directly record the activity of single neurons from the brain, due to ethical reasons," said Lukas Kunz, a postdoctoral research scientist at Columbia University's Department of Biomedical Engineering and first author of the new study. "There are techniques like fMRI or EEG, which allow us to indirectly measure neural activity from healthy human brains, but this neural activity reflects the sum activity of millions of neurons, which does not allow for direct conclusions about the working principles of single neurons."

In the new study, neuroscientists from the US and Germany investigated 15 epilepsy patients at the University Medical Center Freiburg. These volunteers were implanted with electrodes to help doctors monitor their disorder.

The researchers asked the volunteers to perform computer tasks that explored their ability to navigate through virtual environments and to remember where many different objects were located there. At the same time, the scientists recorded the activity of more than 1400 single neurons in multiple brain regions across all the participants.

The scientists identified more than 160 neurons that behaved like egocentric spatial cell types, activating when specific parts of the virtual environment were ahead, behind, to the left or to the right of the patients, or when points in space were close to or far away from the patients.

"We are now the first to report egocentric spatial cell types in humans," Kunz said.

These 'egocentric bearing cells' likely encode spatial information on a mental map centred on each person. "This is presumably important for everyday life, when humans try to orient themselves in their environments and when they navigate along routes," said Joshua Jacobs, Associate Professor of Biomedical Engineering at Columbia Engineering and senior author of the study.

These egocentric bearing cells were particularly ample in the parahippocampal cortex, a region located deep within the brain that prior work suggested is the human equivalent of the rodent postrhinal cortex. Egocentric bearing cells comprised about 25% of all neurons in the parahippocampal cortex. "Previous studies had shown that patients with damage to this brain region are disoriented, presumably because their egocentric bearing cells were affected," Kunz said.

The researchers also found these egocentric bearing cells showed increases in activity when the patients used their memory to successfully recall the locations of objects they had found in the virtual environments. "This suggests these cells are not only relevant for navigation, but also play a role in correctly remembering past experiences," Kunz said.

"Memories consist of multiple different elements, such as a specific event, the place where the event happened and the time when the event happened. We believe that there are different neural systems for the different components of these memories. Egocentric bearing cells are presumably particularly involved in processing the spatial information of the memories."

The team's findings may illuminate what might go wrong in people with memory deficits, including patients with neurodegenerative diseases such as Alzheimer's, with Jacobs suggesting: "Their egocentric bearing cells may not function correctly, or may have been destroyed for some reason, such as a stroke, a brain tumour or dementia." The new findings do not answer how one might deal with such memory impairments, however.

In the future, the researchers want to see why exactly any given egocentric bearing cell is tuned to whatever point in space it is focused on. Currently, Kunz and his colleagues assume that multiple different spatial cues, such as objects, spatial boundaries and landmarks, combine to influence the position of these reference points. The scientists can examine the influence these cues have on the location of these reference points by removing these cues from environments during experiments.

"Another important question is how egocentric bearing cells interact with allocentric spatial cell types," Kunz said. "We currently hypothesise that egocentric bearing cells provide essential input to allocentric spatial cell types. By understanding this, future studies could explain how the tuning of allocentric spatial cell types is influenced by the functioning of egocentric bearing cells."

Enclosures for automated processes

EnviroMax enclosures are engineered to isolate lab automation instrumentation and processes that include liquid handling, powder and sample weighing, and high-throughput screening. They are available in standard sizes or can be fabricated to meet the user's exact size or design specification.

The enclosures can feature either a vented exhaust system to protect the user or HEPA-filtered supply system for clean workstation requirements to protect the process. The bio-enclosure features HEPA-filtered clean supply to protect the process and also a front-face velocity to protect the user.

The enclosures can be built unitised or modular depending on whether they need to be disassembled. Access can be from any or all sides in glass, acrylic or polycarbonate, and either horizontal sliding, vertical sliding or hinged. A wide selection of accessories is available, such as worksurfaces, tables, electrical and plumbing services, ventilation equipment and safety components.

HEMCO Corporation
www.hemcocorp.com

CRISPR products for analysis of gene-editing experiments

QIAGEN's QIAprep&amp CRISPR Kit and CRISPR Q-Primer Solutions allow researchers to analyse edited genetic material with speed and efficiency to determine how their interventions have changed the function of the DNA sequence in question. Short for 'clustered regularly interspaced short palindromic repeats', CRISPR has a host of potential applications, from correcting genetic defects, to treating and preventing the spread of diseases, to accelerating drug discovery and biomedical research.

The CRISPR products provide scientists with a sensitive, all-in-one process for characterising so-called knock-outs generated from guide RNA (gRNA) and knock-ins from small insertions during gene editing. Kit and solutions combine liquid-based sample preparation with downstream PCR detection as well as the Sanger method of DNA sequencing.

The highly sensitive tools should reduce the time to result in experiments, with cell cultivation requirements cut down by seven days compared to existing methods, accelerating research in the field. They thus provide a boost to CRISPR's potential for breakthroughs in biomedical research into cancer, neurological conditions, gene therapy, cell therapy, immunotherapy, regenerative medicine and disease modelling — as well as the discovery of disease-signalling biomarkers and drug development.

The products are optimised for analyses of cells edited with methods such as CRISPR with adherent and suspension cell cultures — including experiments with the proteins Cas9 and Cas12a often used to cut DNA — and can even be used with single-cell inputs. Positive PCR controls for human, mouse and rat are included to determine the effectiveness of gene-editing conditions. Primers for PCR and Sanger sequencing can be easily customised to suit any target.

QIAGEN Pty Ltd
www.qiagen.com

High-temperature HEPA filters for life science facilities

Camfil's range of high-temperature HEPA filters are specifically designed to protect processes at high temperatures and are suitable for use within sterilisation or depyrogenation processes in the life science industry. Tested according to either EN779 and ISO 16890 or EN 1822:2019 and ISO 2963, the high-temperature HEPA filters meet the strictest requirements and maintain their integrity and rated performance under extreme temperatures.

Camfil's Sofilair V-bank style filters are lightweight and suitable for maximum continuous operating temperatures up to 120°C, offering low pressure drop for energy savings and long filter life. Airopac HT and Absolute FRSI box-style filters offer high stability and are suitable for maximum continuous operating temperatures up to 250°C. Typically used for depyrogenation tunnels or ovens and suitable for maximum continuous operating temperatures up to 350°C, Termikfil and Absolute FRK-V box style filters offer mechanical stability in high velocities.

Designed for aseptic filling processes that require maximum production uptime and safety, Camfil's Absolute D-Pyro is a premium high-temperature HEPA filter with a working temperature up to 350°C to peaks at 400°C and tested ramping to +5°C/min. Achieving ISO Class 5 compliance all across the tunnel and H14 compliance in the production 'hot zone' with zero emissions, tempering and cleaning, the Absolute D-Pyro is also designed and manufactured under the Camfil ProSafe Quality & Certification Program.

Camfil Australia Pty Ltd
www.camfil.com.au

Magnetic stirrer

The IKA Midi MR 1 digital is a high-volume magnetic stirrer capable of mixing up to 50 L of liquid solution (H_2O).

The stirrer has a flat and sturdy stainless steel casing with high corrosion resistance and is easy to clean. Its digital LED speed display is designed to allow precise speed adjustments. Other features include a non-locking motor and an infinitely variable speed range from 0 to 1000 rpm. The stirrer can be operated continuously or programmed with the integrated timer.

The stirrer can be connected to a PC and operated with the laboratory software Labworld-soft through the RS 232 or USB interface. The software allows easy data transfer, operation in remote mode and updating of firmware.

Labtek
www.labtek.com.au

The S-Monovette® is the revolution in blood collection.

The S-Monovette is an innovative enclosed blood collection system that allows the user to draw blood from the patient using the syringe or vacuum method, uniting the advantages of both techniques in a single product.

When used as a syringe, the phlebotomist has full control over the speed at which the blood is drawn into the tube. This is particularly useful for patients with fragile veins, such as the very young or elderly, where the use of the aspiration technique prevents even the most fragile veins from collapsing. When the tube has been filled, the plunger is simply snapped off to leave a primary sample tube which can be centrifuged and is compatible with all major analysers.

The S-Monovette can also be used as an evacuated tube by drawing the plunger fully down and snapping it off immediately prior to blood collection. This creates a fresh vacuum and ensures a precise filling volume, ensuring a correct dilution ratio.

The reduced vacuum pressure in the S-Monovette drastically reduces the rate of haemolysis and vein collapse, meaning increased sample quality and reduced costs associated with repeat collections. Furthermore, unlike pre-evacuated tubes, the S-Monovette does not have to hold a vacuum for many months after manufacture, which allows the membrane stopper to be thinner and more easily penetrated by the needle sheath. This minimises the movement of the needle in the vein when attaching the tube, ensuring optimum patient comfort.

The S-Monovette needle is ready to use so that there is no need for assembly to a holder. The needle is of a compact, low profile design, which reduces the chance of haematoma by allowing for a reduced angle of puncture and eliminates the possibility of needle stick injury caused by assembly of the needle and holder. The compact design also results in approximately one sixth of the sharps volume caused by using a pre-evacuated system, giving significant cost savings.

If you would like a visit from one of our Sales Representatives to demonstrate this system, please contact us on **toll free 1800 803 308**.

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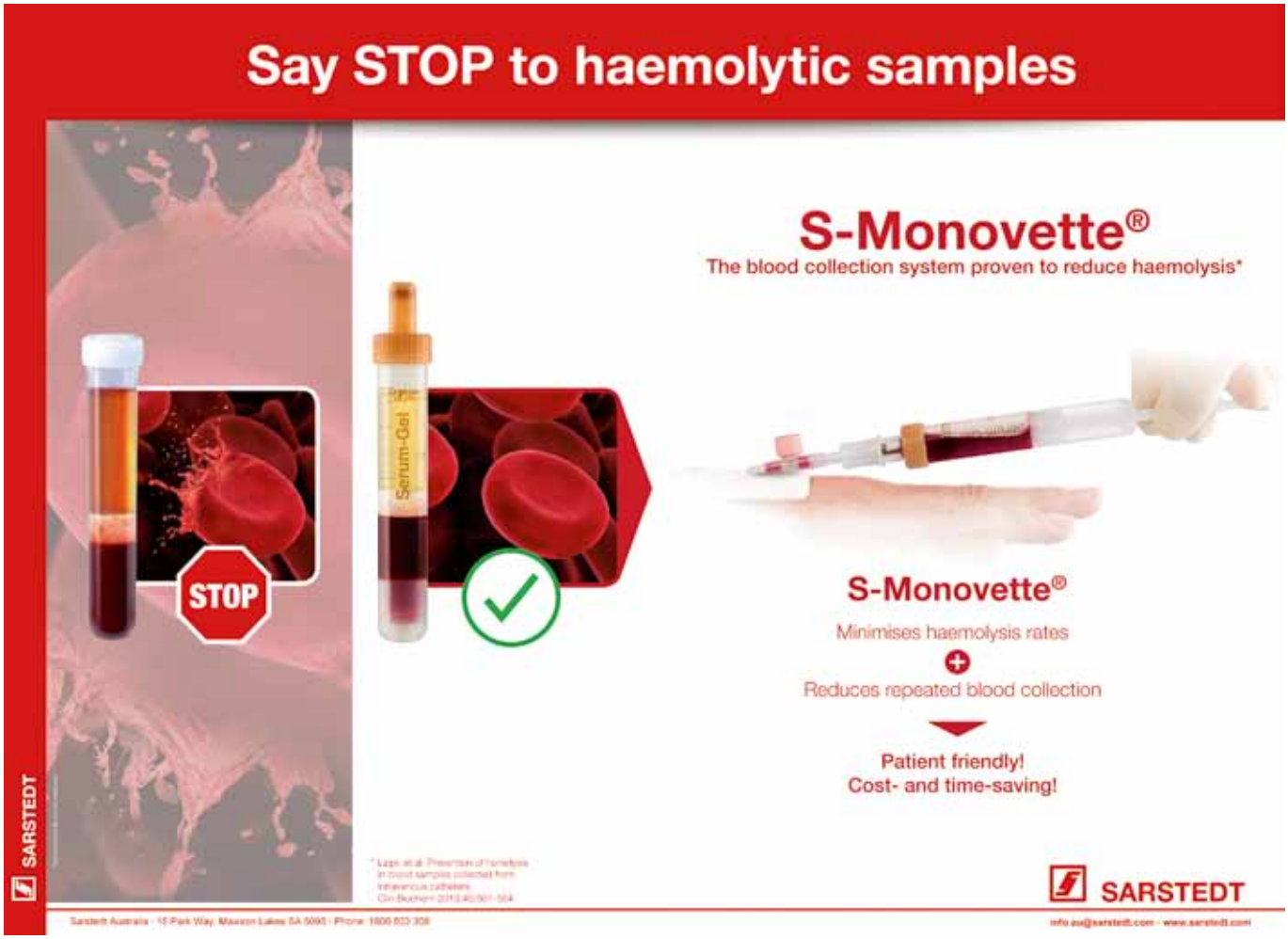


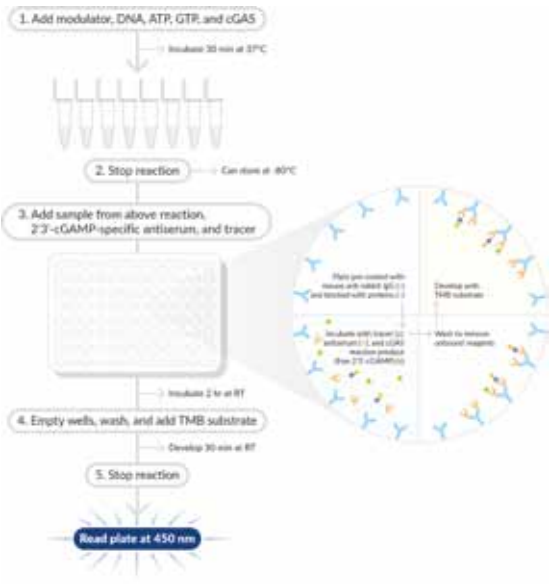
Human cGAS inhibitor screening assay

Cayman Chemical's cGAS Inhibitor Screening Assay Kit provides a robust and easy-to-use platform for identifying novel inhibitors of human cyclic GMP-AMP (cGAMP) synthase (cGAS), a key enzyme in the innate immune response to pathogenic dsDNA.

cGAS is a cytosolic mammalian nucleotidyltransferase that acts as a dsDNA sensor. Upon binding to pathogenic dsDNA, cGAS produces the cyclic dinucleotide second messenger cGAMP, which activates stimulator of interferon genes (STING), leading to activation of the type I IFN pathway as part of the innate immune response. Activation of cGAS and production of 2′3′-cGAMP are important in host defence but may play a role in the development of autoimmune diseases, such as systemic lupus erythematosus. Additionally, cGAS is activated in response to cancer-associated mitochondrial DNA leakage. Inhibition of cGAS activity decreases type I IFN production in patient-derived samples and mouse models of autoimmune diseases, indicating therapeutic utility of cGAS inhibition.

The cGAS Inhibitor Screening Assay Kit allows users to screen for modulators of cGAS activity using a straightforward two-stage method. In the first stage, a 30 min cGAS reaction is conducted, wherein active cGAS enzyme produces 2′3′-cGAMP in the presence of DNA, ATP and GTP. The addition of an effective inhibitor will suppress this reaction. In the second stage, a 2′3′-cGAMP ELISA is used to quantify the cyclic dinucleotide product of the cGAS reaction. This ELISA is a competitive assay with a range of 4.57–10,000 pM, a midpoint of approximately 300 pM (50% B/B_0) and a sensitivity (80% B/B_0) of approximately 50 pM. The kit has a robust Z′ factor of 0.73.

Cayman Chemical Company
www.caymanchem.com



Technology for understanding protein adsorption

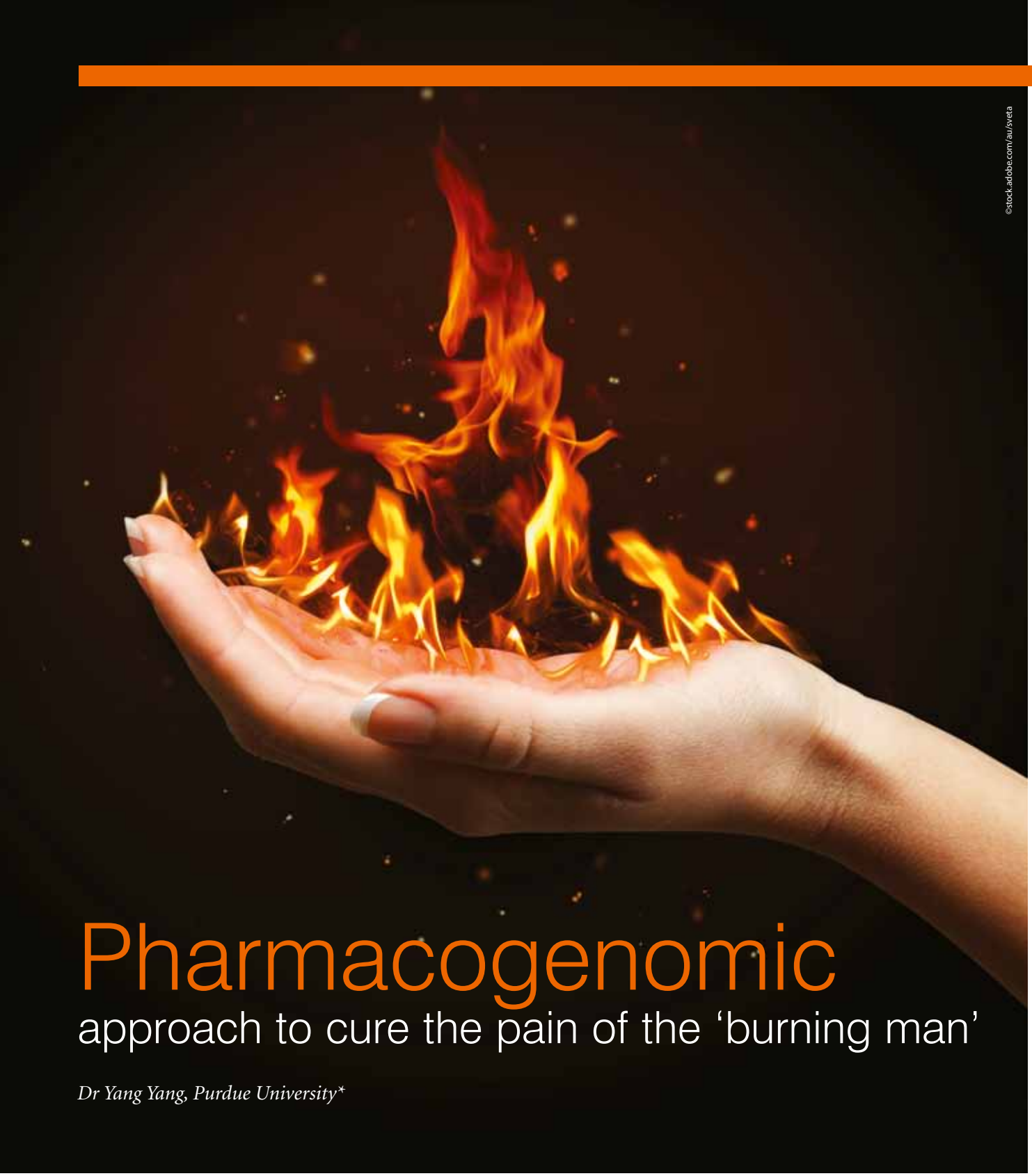
Protein aggregates are a major challenge during pharmaceutical drug development that affects drug quality and safety. Biotherapeutics such as monoclonal antibodies (mAbs), frequently packaged at high concentration in syringes, can become unstable and form aggregates when they interact with the syringe surface coated with a lubricant like silicone oil. These aggregates have the potential to enhance immunogenicity and therefore need to be screened and controlled.

Understanding protein–surface interactions and how proteins adsorb at the silicone oil/water interface can help optimise formulation additives, such as stabilisers and surfactants, as well as the packaging used in the development and manufacture of new protein therapeutics.

Using Q-Sense QCM-D, a surface-sensitive technology that monitors mass uptake at the surface, the protein–silicone oil surface interaction can be analysed in real time. In addition to the mass, QCM-D also senses the structure of the layer adsorbed (or bound) at the surface. The adsorption behaviour of the protein, both in the absence and presence of different surfactants, can also be measured and compared.

In a recent study, a group of researchers set out to study the surface activity of mAbs and whether two commonly used surfactants would lower their likelihood of adsorption and aggregation. Combining insights from the QCM-D analysis with information from complementary characterisation techniques, the study showed a direct relationship between mAbs adsorption at the oil–water interface and aggregation. The study also showed that surfactants, which will competitively adsorb to the interface, will lower the aggregation of the mAbs.

ATA Scientific Pty Ltd
www.atascientific.com.au



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Pharmacogenomic approach to cure the pain of the 'burning man'

*Dr Yang Yang, Purdue University**

Inherited erythromelalgia is a rare and potentially devastating syndrome associated with severe burning pain in the hands and feet, creating a major unmet medical need.

More than 100 million Americans suffer from chronic pain of varying degrees, with the lack of effective but non-addictive painkillers partially contributing to the national substance abuse crisis. Potent opiates are often addictive, while other painkillers may be associated with poor tolerability, resulting in suboptimal pain control from many indications. Developing next-generation painkillers, therefore, has enormous value.

While chronic pain is often caused by injury, it can also be caused by genetic variants that naturally occurred in humans, such as in inherited erythromelalgia (IEM). Also called 'Man on Fire' syndrome, it is associated with chronic burning pain in the hands and feet that cannot be relieved by common painkillers. Research from my work and others has led to new insights into pain pathophysiology in patients with IEM, as well as advancements in therapy.

Researching a treatment solution

The pain associated with IEM is caused by a genetic mutation in the *SCN9A* gene, which produces a hyperactive $Na_v1.7$ sodium channel. The $Na_v1.7$ channel is considered a pain channel since it is directly involved in many human pain syndromes. Through extensive research, we identified more than two dozen *SCN9A* mutations that lead to IEM. Consequently, for these patients, one-size-fits-all pain medication does not work. Currently, IEM treatment is a matter of trial and error. One of our major research goals, therefore, was to develop a precision medicine approach to treating these patients based on their genetic background.

While most patients with IEM do not respond to any available pain medications, there are exceptions. In the clinic, it was found that patients with one particular mutation on the *SCN9A* gene, V400M, responded to a non-selective sodium channel blocker that is traditionally used to treat seizures called carbamazepine (CBZ). Using patch-clamp analysis, it was found that CBZ normalises activation of the hyperactive $Na_v1.7$ mutant and therefore makes it act more like wide-type.

The responsiveness of V400M to CBZ was encouraging and motivated us to identify additional mutations that might respond to the drug. To do this, we constructed a human $Na_v1.7$ 3D structure model to locate IEM mutations. Using this approach, we identified another common IEM-associated mutation, S241T, located very close to V400M. The proximity between these two mutations led us to suspect that they may be affected by CBZ in a similar manner.

Studying IEM with microelectrode arrays

To study the functional consequence of these mutations in intact pain-sensing neurons, and to test how these neurons responded to CBZ, we used microelectrode array (MEA) technology.

An MEA is a grid of tightly spaced microelectrodes, and they're often used in the study of neural activity or circuits. They may be placed in the brains of living animals, but they can also be embedded in the wells of a multi-well cell culture plate allowing for in vitro modelling (Figure 1).

This arrangement allows us to culture sensory neurons in vitro and record the electrical activity noninvasively over weeks to months of these cultured pain-sensing neurons. Also, this technique enables us to grow replicates of the culture and simultaneously test multiple genetic, pharmacological and environmental manipulations (Figure 2). For example, we could study multiple mutations at once, and since IEM is triggered by warmth, we could also test the effect of temperature on the model using a built-in precise temperature control of the MEA system.

Using this MEA system, we performed experiments to address our main question: can we develop a personalised medicine approach to guide the drug selection process for IEM patients based on their genetic background?

MEAs helped identify druggable targets

We grew neuron cultures harbouring one of several IEM-associated mutations. In neurons featuring the S241T mutation, CBZ significantly reduced the firing frequency, as well as the number of active DRG sensory neurons, when compared to vehicle treatment. We found this difference to >

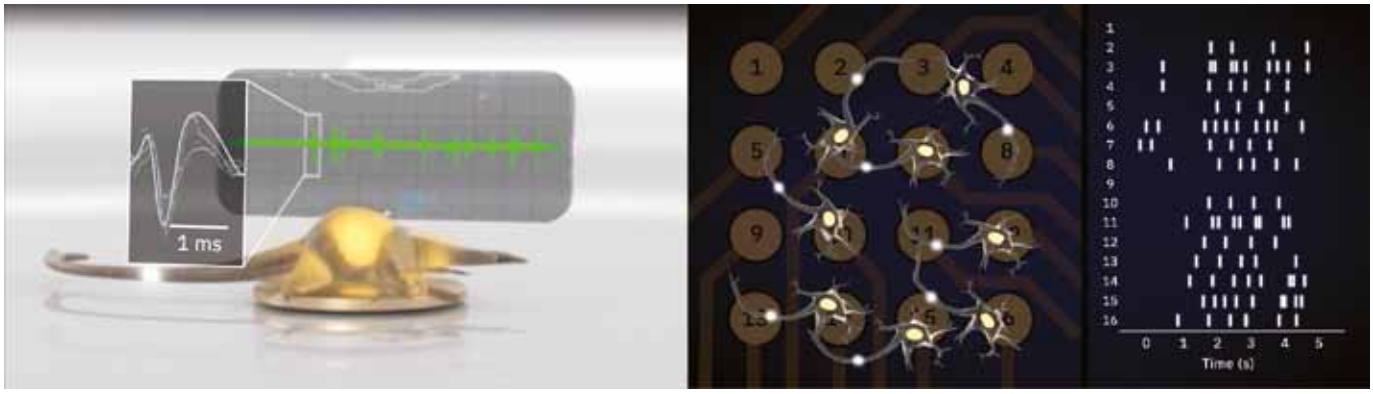


Figure 1: (Left) Image of a neuron grown over an MEA electrode. Voltage activity from the neuron is recorded (green) and individual neural signals or action potentials (white) are automatically tracked. (Right) In an MEA culture dish, the location and time of every recorded action potential (AP) is assigned a tick mark. The relationship between tick marks (or APs) reveals deep insights about how the neurons are interacting.

be statistically significant. Conversely, when we performed this same test on a different F1449V mutation, we found that CBZ does not have a major effect on these neurons.

Altogether, we demonstrated that the effect of CBZ is mutant-specific, suggesting the need for a more personalised approach towards treating IEM. The data suggests that the mutation $Na_v1.7$–S241T may respond to CBZ.

Transferring research to the clinic

Next, we aimed to take our research findings and test them in the clinic. After a nationwide search, we identified two IEM patients carrying the $Na_v1.7$–S241T mutation who were eager to participate in our study. Together with our colleagues, we designed a randomised, placebo-controlled double-blind crossover clinical trial for these two patients. We gave the patients either a placebo or CBZ for six weeks and we recorded their responses in several ways.

We found that CBZ reduced pain more than the placebo did. Specifically, it reduced total pain duration, episode duration and the number of times it woke the patient up during sleep. Together with our colleagues, we also performed functional MRI and found that while the patient on placebo showed brain activity in areas associated with chronic pain, the patient on CBZ showed brain activity in brain areas associated with acute pain — a pattern that indicates that CBZ affects how the brain responds to pain signals in patients harbouring the *SCN9A*–S241T mutation.

These results show that precision medicine, guided by genomic analysis and functional profiling, provides a promising way to transform pain treatment. With continued research and analysis, we aim to shift the paradigm of a trial-and-error approach to identify effective painkillers to a personalised medicine approach based on the genetic make-up of individual patients to treat chronic pain in the near future.

**Dr Yang Yang is currently an Assistant Professor at Purdue University in the Department of Medicinal Chemistry and Molecular Pharmacology, also affiliated with Purdue Institute for Integrative Neuroscience. His current research focuses on pharmacogenomics, induced pluripotent stem cells (iPSCs) and neurological diseases, including chronic pain, epilepsy, autism and neurodegenerative diseases. Using state-of-the-art technologies, Y Lab aims to understand how genetic mutations of key genes including ion channels contribute to neurological diseases, and to develop novel pharmacogenomic approaches for disease intervention.*

Axion Biosystems
www.axionbiosystems.com

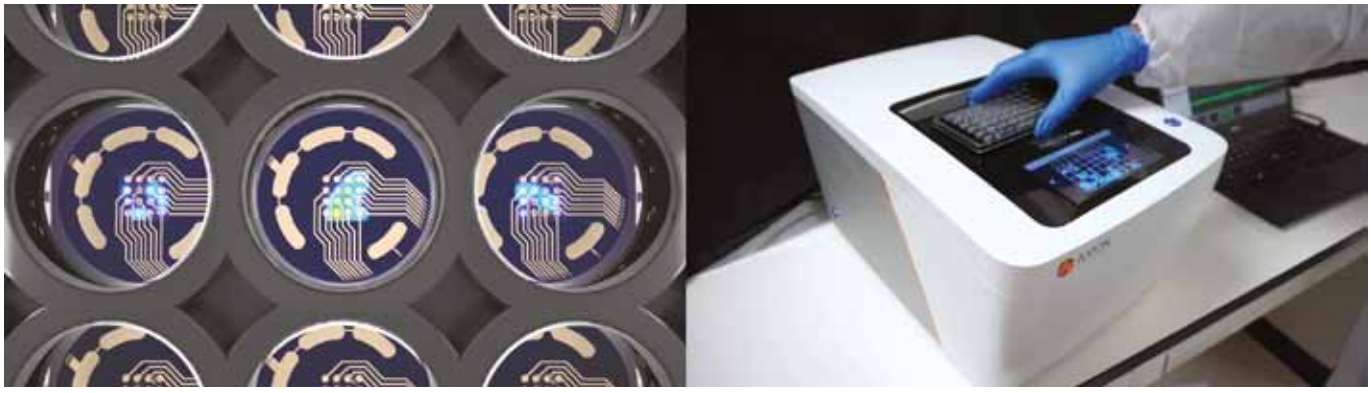


Figure 2: (Left) Multiwell solutions allow scientists to track up to 96 neural cell cultures simultaneously, accelerating scientific discovery and changing the way scientists ask questions. (Right) 48-well CytoView MEA plate being docked into a Maestro Pro MEA system, with built-in precise temperature and CO2 control.

Thermal analysis software

Waters has introduced TRIOS AutoPilot software from its TA Instruments division for its thermal analyser product line. The software is designed to help laboratory staff using TA's thermal analysers create routine and streamlined standard operating procedures (SOPs) up to 25% faster, and avoid transcription errors that can inhibit productivity and lead to inconsistent thermal analysis measurements that are used to assess materials performance as well as batch-to-batch product quality. Whether users are making measurements in a research lab or production environment, the software should help to provide uniform thermal analysis data quickly and reduce costs associated with training and retraining operators to run samples properly.

The software's OneTouch interface guides operators with video and text prompts designed to simplify the process of getting test results. The software comes with a comprehensive set of pre-written express scripts for automating many common procedures such as sample loading, instrument calibration and verification, and formatting and exporting data files into laboratory information management systems (LIMS).

The thermal analysis software is based on Google's visual programming interface, Blockly, which is open-source software that gives operators an intuitive way to create custom scripts and configure them for thermal analysis applications without the need to learn a higher-level programming language. This allows laboratories to capture written SOPs, along with the institutional knowledge of more experienced operators, and codify them into scripts that can be shared throughout the enterprise.

To ensure compliance with regulatory requirements such as 21CFRPart11, the software features built-in audit trails and data integrity options with electronic signatures.

TA Instruments
www.tainstruments.com

Ultralow-temperature freezer

DAIHAN's DuoFreez U700 is a smart, digital, ultralow-temperature freezer (ULT) that has a capacity of 714 L (including four shelves for the five-door option) and a temperature range of -90 to-65°C. The upright freezer features an ergonomic, 7″ full touch screen TFT LCD SmartLab Controller.

The product's self-diagnostics system includes a built-in standard warning and alarm functions. It has dual systems controlling temperature, so if one system fails, an in-built backup system is available and cools to -80°C. It also offers automatic data recording and an Eco mode for low power consumption. CFC-free refrigerants are used.

The product has an automatic vacuum breaker, so it is easy to reopen the door, and an external temperature sensor hole. The use of a block condenser removes the need for a filter and causes of related failure. The filter-free mechanism lowers the heat generated by the compressor.

The system offers a high-quality insulation panel and inner doors that enable defrosting around the outer surface. The door handle has a robust and flexible design and the inner door height is 252 mm for the five-door option. An RS232 communication link and remote control software are supported, and Wi-Fi connectivity allows smartphone app control via the SmartLab Controller.

Pacific Laboratory Products
www.pacificlab.com.au

Automatic potentiometric titration systems

The HI931 and HI932 potentiometric automatic titrators, from Hanna Instruments, are designed to deliver accurate results and an intuitive user experience, all in a compact package. Fully customisable to meet the user's testing needs, the titrators feature a 50% smaller footprint than the company's previous line of automatic titrators to optimise the benchtop and increase productivity.

Both the HI931 and HI932 allow the user to titrate for a variety of measurements at the push of a button, including acids, bases, redox and selective ions. With no additional programming upgrades required, the user can start measuring right away. In addition, the HI932 will allow direct measurements and back titrations for complex samples.

Reports and methods can be transferred to a PC via a USB interface, saved to a USB storage device or printed directly from the titrator. An external keyboard can also be attached for added convenience.

For those that require greater automation, the HI932 can be paired with the HI922 autosampler, automating up to 18 samples.

Hanna Instruments Pty Ltd
www.hannainst.com.au

Automated incubators and storage systems

Pharma and biotech laboratories performing high-throughput screening, high-content screening and molecular cell biology can now benefit from a series of automated incubators and storage solutions that offer large capacity, fast access and a wide temperature range, while helping eliminate contamination issues in high-throughput environments.

The Thermo Scientific Cytomat 24 automated incubators and storage systems are said to bring the latest incubation technology to large capacity microplate incubation applications, with temperature uniformity and stability that enable reproducibility for cell culture applications. The systems provide speedy delivery of microtitre plates through a plate shuttle system to meet the needs of high-throughput laboratories and accelerate research. An LED touch screen is door mounted for easy accessibility and viewing. Convenient onscreen user prompts provide ease of use.

Through a fully automated ContraCon decontamination routine, the automated incubators and storage systems are designed to simplify cleaning and disinfection, which should provide users with confidence in their sample integrity. The automated incubators and storage systems reduce the mean plate access time to 15 s, allowing users to achieve their research goals quickly.

Other benefits include: stable, high relative humidity levels through an integrated humidity reservoir, preventing culture desiccation; alerts indicating when a water refill is required, avoiding the risk of an empty reservoir; user prompts and alerts for parameter tracking; and an optional Hydra smart technology feature for more precise humidity control.

Thermo Fisher Scientific
thermofisher.com

Immune system boosted to fight antibiotic-resistant bacteria

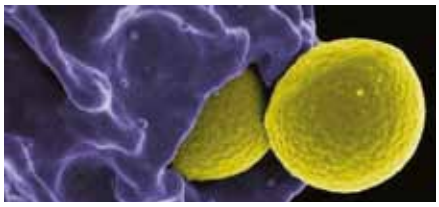
Researchers from Johns Hopkins Medicine have announced an accidental discovery that could be on par with the birth of penicillin — a treatment that may provide an alternative, immune-based solution to the danger of antibiotic-resistant bacterial infections.

As with Alexander Fleming's discovery of penicillin in 1928, the bacterium of note for the Johns Hopkins researchers was *Staphylococcus aureus* — but this time, methicillin-resistant *Staphylococcus aureus* (MRSA), the life-threatening strain unharmed by methicillin and other antibiotics. Serving as senior author on the new study was Dr Lloyd Miller, formerly a professor of dermatology, infectious diseases and orthopaedic surgery at the Johns Hopkins University School of Medicine and now with Janssen Research and Development.

Dr Miller said the research team was originally intending to study the mechanisms behind MRSA skin infections in mice with and without the ability to manufacture interleukin-1 beta (IL-1β). This protein, transformed into its active form by enzymes called caspases, enhances protective immunity by helping immune cells called neutrophils, monocytes and macrophages fight bacterial infections.

"We gave the mice a blocker of all caspases [pancaspase inhibitor], a compound known as Q-VD-OPH, thinking it would leave both sets of mice more vulnerable to MRSA infection," Dr Miller said. "To our surprise, blocking caspases had the opposite effect, resulting in a rapid and remarkable clearing of the MRSA bacteria by keeping the immune cells alive and boosting their protective function."

Sensing they might have accidentally uncovered a means of fighting bacterial superbugs, Dr Miller and his colleagues conducted their latest study to confirm the unexpected finding was not a fluke. The results, published in the journal *Science Translational Medicine*, were encouraging.



Scanning electron micrograph of methicillin-resistant Staphylococcus aureus (MRSA) bacteria being engulfed by an immune cell known as a neutrophil. Image credit: National Institute of Allergy and Infectious Diseases, National Institutes of Health.

"A single oral dose of Q-VD-OPH decreased the size of MRSA skin lesions and rapidly cleared the bacteria compared with vehicle-treated [given the carrier solution without Q-VD-OPH] and untreated mice," said lead author Dr Martin Alphonse, a dermatology postdoctoral fellow at the Johns Hopkins University School of Medicine. "And surprisingly, the treatment worked whether IL-1β was present or not — and without administering any antibiotics."

The researchers found that the pancaspase inhibitor reduces apoptosis — one of three main methods the body uses to remove worn-out or damaged cells — of neutrophils and monocytes, leaving them in plentiful numbers and better able to remove MRSA bacteria.

"It's like a fire department where older firetrucks are kept operating to help put out blazes, when otherwise they would have been taken out of service," Dr Miller said.

The researchers also saw enhanced necroptosis — a second controlled cell death process similar to apoptosis — of macrophages, which are mature monocytes.

"The destruction of macrophages by necroptosis releases [a] large amount of tumor necrosis factor, or TNF, a protein that triggers bacteria-fighting immune cells to swarm into an infected area of skin," Dr Alphonse said.

Finally, the researchers tested whether Q-VD-OPH in mice could have broader activity against two other dangerous skin bacteria, *Streptococcus pyogenes* (the cause of multiple diseases, including scarlet fever, necrotizing fasciitis and toxic shock syndrome) and *Pseudomonas aeruginosa* (often a threat to hospitalised patients on ventilators, with catheters or suffering wounds from surgery or burns). The targeting of the body's immune system against bacteria via pancaspase inhibition — referred to as 'host-directed immunotherapy' — proved just as successful as it had been for MRSA.

"It was an accidental finding by Alexander Fleming that led to the golden age of antibiotics, but now that's nearing the end because of antibiotic-resistant bacteria," Dr Miller said. "It seems fitting that another surprise in the lab could be the start of a second golden age, the use of host-directed immunotherapy."

Spectroscopy and chromatography instrumentation

JASCO is a provider of high-quality spectroscopy and chromatography instrumentation for cutting-edge research, teaching, process and routine analysis. From routine instruments to more complex, custom-designed solutions, the company delivers a range of optical spectroscopy instrumentation. Featuring high specifications, they are compact in design and robust in operation. Models range from entry-level systems especially suited to teaching or QC environments through to powerful and flexible research-grade systems.

The JASCO LC-4000 Series HPLC Systems are the latest innovative HPLC systems developed by JASCO. The concept of the integrated LC-4000 Series modules provides key separation platforms at 50, 70 and 130 MPa, which correspond to conventional HPLC, rapid-analysis RHPLC and sub 2 μm packing particle size UHPLC, respectively. Each platform has a dedicated pump and autosampler matched to the operating pressure. All three platforms share a wide range of detector options, including circular dichroism and optical rotation detectors, all optimised for high-speed 100 Hz data acquisition and the narrow peak shapes common to both RHPLC and UHPLC.

Bio-Strategy Pty Ltd
www.bio-strategy.com

Floor-standing centrifuges

On 1 July 2020, Eppendorf acquired the centrifuge business of the Japanese company Koki Holdings Co., Ltd, whose products are marketed under the brand name Himac. Eppendorf has now launched the Himac CR22N and CR30NX floor-standing centrifuges, expanding its portfolio of high-quality micro and multipurpose centrifuges.

The high-speed (up to 58,700 and 110,000 x g respectively) floor-standing centrifuges and comprehensive rotor portfolio are designed to support the user in every step of their centrifugation workflow, offering high efficiency and throughput for processing of up to 6 L of cell culture with flexible volumes. The CR22N is designed for cell harvesting applications, while the CR30NX offers a high-speed multipurpose solution. Both models can use the 1.5 L triangular bottles from Himac, which offer easy and time-efficient harvesting of cell, yeast and bacterial cultures (up to 15,100 x g).

To help maintain premium performance and maximum safety of the instruments, Eppendorf provides a comprehensive range of carefully designed service solutions performed by its dedicated Technical Service teams worldwide.

Eppendorf South Pacific Pty Ltd
www.eppendorf.com.au

Ultrahigh-contrast DMD pattern illuminator

Mightex's Polygon DMD pattern illuminators provide spatiotemporal control of light with subcellular resolution, making them a suitable illumination tool for life science research. The Polygon UHC incorporates the latest in digital micro-mirror technology to achieve a contrast ratio of 10,000,000:1, unlocking further research opportunities for the bioscience community.

The product can create optogenetic grid scans with a large number of grids for high spatial resolution circuit mapping. This allows the user to target optical stimulation to small regions of interest. As only the regions of interest are targeted by photostimulation, this decreases unwanted photo-activation of surrounding light-sensitive areas in the tissue of interest.

The product is designed to produce more grey levels, leading to seamless optical intensity application. This large dynamic range is relevant for studies requiring fine control of low-intensity stimulation parameters, such as retina-related studies. The device can be seamlessly integrated with two-photon microscopes, allowing for easy transition between patterned stimulation and two-photon imaging.

SciTech Pty Ltd
www.scitech.com.au

Accurate mass system

SCIEX introduces the ZenoTOF 7600 system. The high-resolution accurate mass system combines the power of Zeno trap pulsing with EAD (electron activated dissociation) fragmentation technology to unlock sensitivity gains that could reveal new, rare or even previously undetected information on an everyday basis.

Users can detect up to 20x more ions in every experiment, the company says, and access a spectrum of tunable fragmentation techniques to uncover new perspectives for every molecule in every experiment.

AB Sciex Australia Pty Ltd
www.sciex.com

Linearity in weighing instruments:
an explainer

You're browsing technical documents to see if a weighing instrument's specs match your requirements, and you keep seeing 'linearity'. What is linearity? Why should you care? What does it mean in the weighing industry? Why are there plus and minus symbols? We'll answer your questions about linearity, and help you understand why it's relevant.

What is linearity?

We define linearity as the ability of a scale or balance to show the correct value throughout the weighing range. Linearity is typically tested by placing known weights on the balance from near zero to full capacity.

It is 'linear' because if you graphed ideal results, you should get a fairly straight line. The plus and minus signs are a range of permissible error. Even the most accurate balances are not perfect all the time, but depending on the application, a small margin of error can be tolerated, as it is not high enough to cause major variations in results. So in our graph example, you would see the straight line (indicating perfect linearity) and two lines indicating the + and -. The actual results will show as an S curve. The scale's results are permissible as long as they remain in that acceptable zone, even if they are not on the perfect line.

Linearity affects not only subsequent measurements, but measurements with important weight differences (for example, a lab balance weighing a small amount of powder, then a larger sample). You want to make sure that when you take advantage of the scale's capacity, the margin of error and the accuracy of the scale or balance remains consistent whether you weigh a small envelope or a large, heavy package. Linearity ensures that no matter the amount of matter that is measured, the results will be accurate and precise as long as they're within the capacity and readability.

Linearity and sensitivity

Because of the nature of linearity, linearity errors can sometimes be perceived as sensitivity errors. This is especially noticeable with laboratory balances, as they are very sensitive to the minutest changes and have low capacities. Sensitivity can be affected by a wide range of factors such as environmental conditions, mechanical or electronic issues or even infrequent calibration. It can be defined as the change in the result's reading when compared to the change in load. Some balances allow users to use filters that adjust a balance's sensitivity to compensate for moving subjects or vibrations.

Linearity, by contrast, is not affected by the environment, but by the changes in mass between samples. While you need to account for sensitivity when conducting linearity testing (to make sure your margin of error is due to the scale's performance and not temperature changes, for example), linearity does not concern external factors and is only applicable to the balance's ability to give consistent measurements when scaling masses. For example, you could put a 100 g weight on a balance. Even if the balance read 130 g, it could still be linear if you put a 200 g weight on and it read 230 g.

How is linearity different from repeatability and reproducibility?

Repeatability is the ability of the weighing instrument to give the same result for the same object under the same conditions every time, while reproducibility is the weighing device's capacity to give the same results for the same object when measured by a different user. Linearity encompasses the scale or balance's full capacity and ensures the

results are reliable even when different amounts are measured.

For example, to test repeatability, you would keep measuring the same known mass to make sure you keep getting the same results. For reproducibility, you would measure the object, then have someone else measure the same object and check if your results differ. Linearity is a bit more complex. You're not only testing that multiple known masses are within standard deviation, but also checking that the deviation does not change depending on the mass. If your standard deviation is of 0.1% for 1 g, it needs to be the same amount for 1 kg.

How can you test linearity?

It's a little like calibrating a balance: you need to use multiple test weights that will approximate the weighing range of the instrument you are checking. The masses must be comparable to each other and within the range you are checking. Using known weights is an easy way to do it, so a calibration weight set is the ideal tool for the job. If you use inadequate weights, you could get unreliable data. Measure each mass and record the result exactly.

If a specific weighing range seems to be giving off more errors, you can make more tests specifically in that range as needed. You can create a table, or plot the results in Excel (you can find tutorials if you're not sure how to do this). Some organisations, especially laboratories, often have specialised software that can calculate the results. If that is the case, follow the procedures outlined by your organisation.

You can graph the results with software, like our AdamDU data collection program, which is designed to work with scales and balances, and can export results to a wide variety of applications as needed. Trace one line for perfect results, one with the results you obtained for corresponding masses. Then trace a line for each of the highest and lowest standard deviations according to the specs of your weighing device. For example, if you're using an SAB 124e analytical balance, the linearity should be 0.0003 g. Make sure you check the specs! Even if balances have the same capacity and readability, they could have different linearities depending on the brand or even the range. You plot one line for the + and one for the -. Your measurements should fall within these two lines. If they don't, you can calculate the error margin and find where it appears.

What do I do if the linearity's error margin is too wide?

You should make sure the weighing device is in a proper area, not close to heat sources, air currents, static electricity and other conditions that could affect readings. Even though linearity is not affected by outside factors, your scale may be giving you unreliable results interpreted as a linearity error because of poor conditions.

Clean and calibrate the scale. If the errors persist and are reproducible, you'll have to call a technician to repair the weighing device.

Linearity is a complex topic worth understanding to get the most out of your scale or balance. If you have any questions, feel free to contact us.

Adam Equipment Inc
www.adamequipment.com.au

Microbioreactor

Microbioreactor technology is accelerating and increasing automation capabilities with the launch of the BioLector XT Microbioreactor, which features high flexibility, enabling more applications in the BioLector series of instruments from m2p-labs — part of Beckman Coulter Life Sciences' Biotechnology Business Unit.

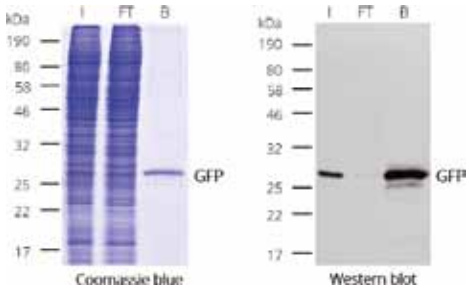
Equipped with FlowerPlate microtitre plate technology, the BioLector XT Microbioreactor enables high-throughput strain screenings, cultivation parameter monitoring and feeding strategy optimisation. It is suitable for microbial, fungal and algal cultivations with real-time evaluations of biomass, pH, dissolved oxygen (DO) and fluorescence for aerobes and anaerobes.

Features include disposable 48-well microtitre plates (MTPs) with online measurements and a simultaneous pH control and feeding managed by patented microfluidic technology. The microbioreactor includes flexible combinations of feeding profiles with customisable protocol settings.

Another powerful feature is the ability for gassing with up to 100% oxygen, due to an innovative lid which also allows for anaerobic fed batches. The gassing lid is designed to reduce gas consumption and provides an airtight anaerobic chamber. The chamber can be used in combination with the microfluidic module to design and test pH-regulated fed-batch microbiome processes without the need to house the system in an anaerobic tent.

Beckman Coulter Australia
www.beckman.com.au

Immunoprecipitation products



The immunoprecipitation of very large proteins, oligomers or complexes and the Co-IP of bulky/multiple binding partners may be challenging when using porous beads. The size of the pores of agarose or magnetic agarose beads is limited and hence this may exclude molecules from diffusing into the pores and prevent effective interaction with the binding ligand. Also, the molecule's shape may similarly limit diffusion into the pores. Therefore, binding can only occur on the outer surface of the agarose or magnetic agarose beads, which results in a poor immunoprecipitation performance.

ChromoTek's Magnetic Particles M-270 are non-porous, solid particles with recombinant single domain V_HH antibody (aka Nanobody) ligands coupled onto their surface. Hence all sizes of tagged proteins — including very large tagged proteins, oligomers and complexes, including bulky binding partners — will effectively bind to the Nanobodies coupled to the Magnetic Particles M-270, enabling simple and efficient immunoprecipitation.

Available from ChromoTek are three Nano-Traps with the Nanobody coupled to the Magnetic Particles M-270. These are the GFP-Trap, RFP-Trap and Spot-Trap.

ChromoTek's range of available Nano-Traps with Nanobodies coupled to agarose beads, and in some cases also available coupled to magnetic agarose beads, include these Nano-Traps: GFP, GST, Halo, MBP, Mdm4/HdmX, MK2, mNeonGreen, Myc, p53-C-term, p53-N-term, PARP1, RFP, SNAP/SLIP-tag, Spot, TurboGFP and V5.

BioNovus Life Sciences
www.bionovuslifesciences.com.au

Pumps and tubing

Thermo Fisher Scientific is a supplier of Masterflex pumps and tubing. The broad range of pumps and fluid system components is suitable for a variety of laboratory, analytical and industrial process applications.

Masterflex's versatile and convenient modular design systems allow laboratory staff to use one pump drive for many applications. In addition, the easy-loading pump head design, coupled with a variety of specialty and general-use tubing formulations, makes Masterflex suitable for all fluid handling needs.

Masterflex has more than 55 years of manufacturing experience in peristaltic pumps, making it a fluid handling expert. With the help of the Thermo Fisher Scientific technical and application team, the companies should be able to assist with all pump system needs.

Thermo Fisher Scientific
thermofisher.com

Livecyte's Automated Tracking exposes a global research dilemma

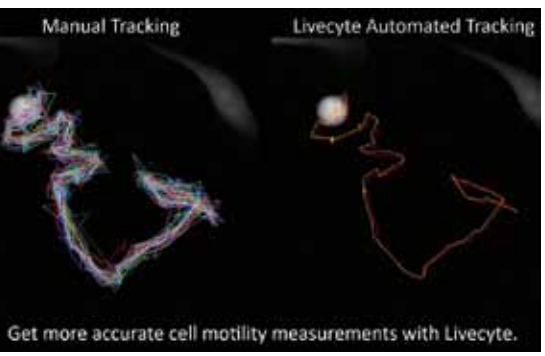
Cell migration is an essential and highly regulated process involved in many areas of biology, including embryonic development, tissue homeostasis and regeneration. Cell migration also plays a key role in cancer, where it drives tumour metastasis.

Monitoring cell migratory behaviour over long periods of time requires imaging techniques with very low phototoxicity. Conventionally techniques such as brightfield or phase contrast imaging are used, but these modalities are poorly suited to automated cell identification. Thus, many researchers are forced to track cell motion by hand in order to understand their migratory behaviour.

Why is that a problem?

Manually tracking cells is not only extremely time-consuming and laborious — https://vimeo.com/553476933 — perhaps even more critically, manually tracking cells is not as accurate as people assume and significant variability can occur from person to person.

Whilst manual tracking is commonly deployed throughout the time-lapse, it is time and labour intensive, and suffers from inter-operator variability, ill-defined cell centroid positioning, and an intrinsic lack of morphological data[1]. In many cases, the vast number of cell images collected during a time-lapse means only a subset of cells is tracked within a population, leading to a poor approximation of migration rates. Multiple available tracking tools offer a certain level of image pre-processing and background filers which may also perturb tracking measurements from one user to the next, depending on the method of tracking used[1].



What is the dilemma?

The promise of time saving and accuracy with automated tracking isn't as easy as simply writing an algorithm; a fundamental change to the way cells are analysed is essential. This may be a rethink of our reliance on fluorescence microscopy. Adherence to the doctrine that accurate live cell tracking needs time, minimal photoperturbation and excellent contrast is paramount.

How does Livecyte solve this?

Automated tracking allows for the analysis of large time-lapse data sets to truly understand and analyse cell behaviour in an efficient, reproducible, and statistically robust way[2]. Most simple automated tracking approaches, however, are dependent on high contrast images (as seen in fluorescence) where cells may be segmented by thresholding, i.e., pixels above an intensity threshold are seen as cell and the rest is background.

Livecyte uses a quantitative phase imaging modality called ptychography which is both ideally suited to automated cell tracking and extremely low phototoxicity. Additionally, we show Livecyte's single-cell tracking is accurate and provides outputs consistent with averaging the manual tracking of many users. Livecyte's Analyse software has easy-to-use algorithms that automatically segment and track all cells in a field of view, removing the subjective nature of the manual approach by standardising the tracking process as articulated in the application note "Uncovering the inconvenient truth behind manual tracking"[3]. (https://bit.ly/3hLIXAX)

How do you learn more?

ATA Scientific can assist with demonstrations, seminars, information, papers, application scientists and importantly facilitate a conversation with Phasefocus if required. Please contact Peter Davis at ATA Scientific: pdavis@atascientific.com.au

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2. Meijering, E., Dzyubachyk, O. and Smal, I., 201 Methods for cell and particle tracking. In Methods in enzymology (Vol. 504, pp. 183-200). Academic Press.
3. https://www.phasefocus.com/resources/tech-notes/uncovering-inconvenient-truth-behind-manual-tracking

ATA Scientific Pty Ltd
www.atascientific.com.au

Blood test monitors cancer treatment outcomes in real time

Cancer patients who are undergoing targeted therapy can look forward to a new blood test that could tell their doctors whether the treatment is working, within one day after the start of the treatment. This should significantly speed up the evaluation process and enable doctors to make adjustments to the treatment plan, if necessary, to improve patients' chances of recovery.

Unlike conventional chemotherapies that interfere with all rapidly dividing cells and can cause widespread damage to cells, targeted medicines attack specific molecules that instruct cancer cells to grow and spread, and in turn, block the abnormal growth of the cancer. Despite the specific nature of targeted drugs, current clinical evaluation of their treatment in solid tumours primarily relies on either tumour volumetric imaging, which is insensitive and delayed, or invasive tissue biopsies.

Assistant Professor Shao Huilin and her research team from the Department of Biomedical Engineering and Institute for Health Innovation & Technology (iHealthtech) at the National University of Singapore (NUS) have now developed a technology that is less invasive and significantly brings forward the evaluation window. Their technique, termed extracellular vesicle monitoring of small-molecule chemical occupancy and protein expression (ExoSCOPE) and described in the journal *Nature Nanotechnology*, takes advantage of extracellular vesicles (EVs) secreted by cancer cells and circulating in blood as a reflective indicator of drug effectiveness in solid tumours.

"Conventional procedures such as tumour imaging are not only expensive but also delayed. For these methods, treatment effectiveness can only be determined after weeks," Asst Prof Shao said. "Using the ExoSCOPE, we can directly measure the outcomes of drug effectiveness within 24 hours of treatment initiation. This will significantly reduce the time and cost for cancer treatment monitoring.

"This method requires only a tiny amount of blood sample for the analysis and each test takes less than one hour to complete, so it is less invasive and yet more informative. In this way, doctors could monitor a patient's response to treatment more regularly during the course of the treatment and make timely adjustments to customise the treatment for better outcomes."

To achieve sensitive and rapid analysis of drug efficacy through blood samples, the NUS team developed the ExoSCOPE as an integrated nanotechnology platform. It measures EVs, which are membrane vesicles of dimension at least a hundred times smaller than the diameter of human hair and invisible under conventional light microscopy.

During successful cancer treatment, when a targeted cancer drug attaches to a cancer cell and interferes with tumour growth, the treated cell will release into the bloodstream EVs containing the drug. The ExoSCOPE platform harnesses a complementary approach of chemical biology and sensor development to measure these delicate drug changes in EVs.

"Current technologies to measure drug–target interactions require complex processing and invasive tissue biopsies, limiting their clinical utility for cancer treatment monitoring," said Dr Sijun Pan, Research Fellow from iHealthtech and co-first author of the study. "By using specially designed chemical probes, our platform is highly sensitive in capturing and labelling EVs in a small blood sample in order to assess drug–target interactions."

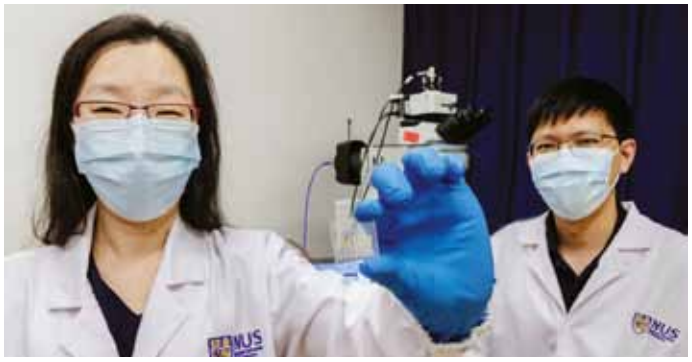
"The ExoSCOPE sensor contains millions of gold nanorings to capture the EVs and amplify their drug labelling signals to induce strong light signals," added Zhang Yan, a doctoral student

from Department of Biomedical Engineering and iHealthtech and co-first author of the study. "These light signals are then processed to give a readout to indicate drug effectiveness."

Using the ExoSCOPE platform, the team collected information on different types of EVs and their drug changes, when treated with various targeted therapies. The platform not only identifies cancer-released EVs, it also monitors their drug dynamics over time to accurately distinguish treatment sensitivity and resistance.

"Existing blood pharmacokinetic or pharmacodynamic approaches measure the total drug concentration in blood," Asst Prof Shao said. "This ensemble information does not reflect drug efficacy in tumours. The ExoSCOPE, however, measures drug changes in cancer-released EVs to accurately reflect tumour treatment responses."

In a clinical trial involving 163 blood samples from 106 patients, the ExoSCOPE has shown encouraging results on lung cancer patients to enable timely evaluation of patients' targeted treatment outcomes. Compared against the gold standard of tumour volumetric imaging, which was performed at the end of the entire treatment regimen, the ExoSCOPE achieved an accuracy rate of 95%, within 24 hours of treatment initiation. The technique's high analytical performance thus paves the way for the use of bloodborne EVs for monitoring different interactions between drugs and protein targets in the human body.



Assistant Professor Shao Huilin (left), Dr Sijun Pan (right) and their team have developed ExoSCOPE, a blood test that measures the effectiveness of cancer treatment within 24 hours after treatment initiation.

"The ExoSCOPE presents a paradigm shift in blood-based drug evaluation for targeted drug selection and real-time treatment monitoring," Asst Prof Shao said. "The technique can also empower the clinical community to make more timely treatment decisions."

The nine-member NUS team took two years to develop and validate the ExoSCOPE platform. Their next challenge is to expand the platform to measure the efficacy of different drugs and apply the technology to a spectrum of diseases from cancers to cardiovascular and neurological disease. A patent has been filed for ExoSCOPE and the NUS team hopes to bring this technology to market in the next three years.

"I hope our technology can contribute towards personalised treatment, to guide the selection, dosage and duration of different treatments, and improve treatment outcomes," Asst Prof Shao said.

Chilled mirror hygrometer

Michell's S8000 -100 is a high-precision, low-dewpoint hygrometer designed to meet the demands of humidity calibration and standards laboratories. The company's engineers have used the latest developments in chilled mirror technology to achieve repeatable measurements of low dewpoints down to -100°C, with an accuracy of ±0.1°C, without the need for additional cooling.

At the heart of the instrument is an optics system that detects minute changes in moisture condensed on the mirror surface. This enables high sensitivity and fast response to changes in frost point, even at low levels of humidity, where measurements are the most challenging. The chilled mirror hygrometer achieves ±0.25°C stability @-100°C fp in <6 h and achieves a reproducibility of ±0.15°C fp reproducibility at -100°C fp.

Offering frost-point measurements down to -100°C, the compact device weighs 22 kg and fits into the 19″ rack format or can be used comfortably on a bench. There is no need for operators to monitor the instrument continuously as it offers complete automation and remote monitoring via software. The wide range of communication protocols includes Modbus RTU over USB, RS232, RS485 and Modbus TCP over Ethernet. Datalogging to SD card and user-configurable analog outputs is also available.

Typical applications are as a reference hygrometer in standards laboratories and humidity calibration facilities, and precision moisture measurements for research and development.

AMS Instrumentation & Calibration Pty Ltd
www.ams-ic.com.au

Differential scanning calorimeter

The NETZSCH DSC214 ***Nevio*** is an intelligent, compact heat flux differential scanning calorimeter (DSC), designed for the pharmaceutical and cosmetics industry.

The instrument is suitable for compatibility studies (eg, for API-excipient combinations), purity assessment, characterisation of phase transformation and determination of material properties such as melting point, glass transition temperature and heat of fusion. The DSC214 ***Nevio*** covers a temperature range of -170 to +600°C and meets the requirements of 21 CFR Part 11.

The optional autosampler, together with the fast heating and cooling capability (up to 500 K/min), maximises productivity and sample throughput. Measurements are based on methods and can contain specifications for measurement conditions and evaluation of the resulting DSC curves. If Autoevaluation is selected, autonomous evaluation of the measurement curves is possible, even if there is a different curve form each time.

NETZSCH Australia Pty Ltd
www.netzsch-thermal-analysis.com

Fully automated, high-throughput pipette tip washers

Grenova produces a benchtop, robotic-arm friendly, high-throughput automated pipette tip washer, designed to provide endless possibilities for developing a reuse process. As pipette tips are experiencing a critical shortage, the company offers a solution that should protect supplies, cut costs and control the lab's supply chain.

Since 2014, Grenova has provided the lab industry with patented and scientifically proven green technology capable of washing, sterilising and reusing pipette tips in large quantities. Over 100,000,000 pipette tips have been washed and reused by Grenova, proving the safety and effectiveness of the technology. The tip washers were developed and have been tested in CLIA- and CAP-approved labs on multiple assays without carryover. In addition, they are implemented by the NIH, NCI and CDC.

Labs that leverage Grenova technology have reportedly experienced the following results: pipette tip consumption reduced by 90%; significant cost savings; reduction in plastic waste impacting the environment; no supply shortages; improved lab efficiency; zero carryover effect; and improved sustainability rating.

The TipNovus and TipNovusMini enable labs to reuse plastic pipette tips numerous times. Featuring a built-in dryer and simple user interface, each machine is designed to reduce costs and waste. The method of wash and sanitation is safe for both the lab and the environment. Meanwhile, TipLumis is a HEPA-filtered, temperature-controlled storage cabinet that is used to expedite the drying process within a clean environment.

Bio-Strategy Pty Ltd
www.bio-strategy.com

AACB conference
coming to Brisbane

Lisa King, Event Manager

On behalf of the Australasian Association for Clinical Biochemistry and Laboratory Medicine and the 2021 Scientific Program Committee, it gives me great pleasure to invite you to Brisbane for the 58th AACB Annual Scientific Conference.

This year marks a significant milestone in the AACB's journey. 2021 is the 60th anniversary of the formation of the AACB. So, we would like to acknowledge and celebrate this achievement at this year's conference. It will be a chance to thank our members and recognise their collective contribution over the years. As Winston Churchill once said, "The farther backward you can look, the farther forward you can see." So, in reflecting on our past we can set the AACB up for future success.

Come also and enjoy the warm weather and many attractions that Brisbane and its surrounds have to offer: from the fantastic beaches close by, including the Gold and Sunshine Coasts (one-hour drive), to the numerous dining experiences and tourist attractions in easy walking distance from the conference venue.

Join us in Brisbane in September!

AACB (Australian Association of Clinical Biochemists)
www.aacb.asn.au

What: AACB 58th Annual Scientific Conference
When: 28–30 September 2021
Where: Royal International Convention Centre, Brisbane, and online
Web: https://aacb.eventsair.com/aacb-58th-annual-scientific-conference/

Cutting-edge Symposium on Integrated Systems Biology: Challenges and Future Perspectives

October 25–27, Brisbane and online

The goal of systems biology is to understand the emergent properties of a biological system by measuring and analysing its many individual components. Yet there remain steep challenges in the analysis of these collective data, particularly in terms of integrating the information derived from across the different planes of biology. This symposium is a chance to learn about the most recent developments in integrated systems biology and their application. It will also offer a forum to identify and then work together to address the challenges associated with this discipline. This forum seeks to take the community forward in an effort to develop truly integrative systems biology research tools that maximise the utility of this practice and the impact that it can help to deliver. It will be attended by delegates from across government, industry and academia, with an exciting line-up of invited speakers.
https://wp.csiro.au/sisb/

Sydney Science Festival 2021
August 13–22, online
https://sydneyscience.maas.museum/

HGSA 44th Annual Scientific Meeting
August 14–17, Adelaide and online
https://aacb.eventsair.com/hgsa-44th-annual-scientific-meeting/

National Science Week 2021
August 14–22, Australia wide
https://www.scienceweek.net.au/

AIMS National Scientific Meeting 2021
August 30–September 1, online
https://aomevents.eventsair.com/aims-national-scientific-meeting-2021/

Falling Walls Lab Australia 2021
September 1, online
https://www.science.org.au/news-and-events/events/international-events/falling-walls-lab-australia-2021

ASCIA 2021 Conference
September 1–3, online
https://www.ascia2021.com/

ARPS 2021
September 13–16, Canberra
https://arpsconference.com.au/

Australasian Exploration Geoscience Conference
September 14–20, Brisbane
https://2021.aegc.com.au/

AACB 58th Annual Scientific Conference
September 28–30, Brisbane and online
https://aacb.eventsair.com/aacb-58th-annual-scientific-conference/

foodpro 2021
October 10–13, Sydney
https://foodproexh.com/

Materials Oceania 2021
October 11–14, Brisbane and online
https://www.materialsconferenceaustralia.com/

AIMS TAS Branch Scientific Meeting 2021
October 16, online
https://www.aims.org.au/events/event/tas-branch-scientific-meeting-2021

Collaborate Innovate 2021
October 18–20, Canberra
https://collaborateinnovate.com.au

AusBiotech 2021
October 25–29, Melbourne and online
https://www.ausbiotechnc.org/

Acoustics 2021 Wollongong
November 8–10, Wollongong
https://www.acoustics.org.au/Acoustics2021/Home/Acoustics2021/Home.aspx

AIMS NSW North Coast Division Conference 2021
November 12–14, Armidale
https://www.aims.org.au/events/event/nsw-north-coast-division-conference-2021

Food Structure, Digestion & Health International Conference
November 16–19, online
https://events.csiro.au/Events/2021/April/23/Food-Structure-Digestion-Health-International

9th International Conference on Environment Pollution and Prevention
November 19–21, Sydney
http://www.icepp.org/

6th International Conference on Frontiers of Composite Materials
November 20–22, Melbourne
http://www.icfcm.org/

16th Congress of the FAOBMB
November 22–25, Christchurch and online
https://www.faobmb2021.org/

EQUS Annual Workshop 2021
December 1–3, Noosa
https://equs.org/events/equs-annual-workshop-2021

Food for Thought: The Future of Food and Nutrition
December 14, Canberra and online
https://www.science.org.au/news-and-events/events/food-thought-future-food-and-nutrition

Lorne Cancer 2022
February 10–12, Lorne and online
https://www.lornecancer.org/

Lorne Genome 2022
February 13–16, Lorne and online
https://www.lornegenome.org/

Pathology Update 2022
March 4–6, Sydney
https://www.rcpa.edu.au/Events/Pathology-Update

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