Radiotherapy: Nuclear waste as a potential source?

Molecular radiotherapy shows great potential in becoming a more mainstream treatment for cancer, but the field is being hampered by a limited radionuclide supply.

Report: Mark Nicholls

Delegates to the virtual NCRI (National Cancer Research Institute) festival session “How do we make the most of molecular radiotherapy? Novel radiotherapeutics and individualised therapy” heard details of the rapidly advancing area of molecular radiotherapy with presentations covering clinical developments, radiation physics and radiochemistry. The session was co-CHAIREd by Dr Glenn Flux, Head of Radioisotope Physics at the Royal Marsden Hospital and Institute of Cancer Research in London, and Professor Jon Wadsley, a Consultant Clinical Oncologist at Sheffield Teaching Hospitals NHS Foundation Trust and the Weston Park Cancer Centre in the UK. In his opening remarks, Professor Wadsley attested to molecular radiotherapy being a growth area on its way from the treatment of rare-niche cancers to a more mainstream therapy. However, he conceded: ‘There is still a lot we don’t know about how we make best use of molecular radiotherapy.’

Among these areas, highlighted by the NCRI Clinical and Translational Radiotherapy Research Working Group (CTRad) to develop the field in the UK, are the need for an appropriate infrastructure in terms of equipment and workforce; the importance of developing an evidence base for these treatments, and optimising molecular radiotherapy treatments, particularly through dosimetry and being able to personalise treatments. While some progress has been made in these regards, ‘there is still a lot of work to be done,’ he added. Advances were also being hampered by an insufficient supply of radionuclides in the UK, and funding issues for studies in this field.

The potential of molecular radiotherapy

Dr Jane Sosabowski, from the Barts Cancer Institute (BCI) at Queen Mary University of London, looked at the future growth and potential of molecular radiotherapy. During her presentation “Novel radiotherapeutics and the growth of molecular radiotherapy,” she reported on the field’s unprecedented expansion, with much excitement generated around radionuclides. Cytotoxicity of these alpha particles had been cause for concern – however, these appear to have alleviated and made way for a new prospect of wider use of molecular radiotherapy, Dr Sosabowski said. There is also some exciting work going on in moving from beta particle emitters to alpha particle emitters, which seem to have some really remarkable therapeutic effects. However, she pointed out ongoing availability issues for radionuclides, which threaten to hold back further progress. ‘We cannot do anything unless we have access to these radionuclides if we want to work with alpha therapies, which is really where most of the research interest is focused at the moment.’

In the UK, the lack of domestic supply sources complicates the issue. Creating radionuclides from nuclear waste is a potential solution, which is currently being explored by the National Nuclear Laboratory. Sosabowski reported. She expressed hope for the industry to find additional ways to increase production, putting an end to this issue and paving the way for further advances in molecular radiotherapies. Beyond this, the expert urged the nuclear medicine community to be ready for upcoming new therapies: ‘We will see some expansion in PET to be able to see if patients are eligible for treatments, but also to follow response to therapy, to see the diagnostics and therapeutic radionuclides go hand in hand.’

Due to the critical shortage in the UK, advances associated with alpha particle emitters are mainly seen in the US and Europe, where availability is better. However, there remains an ambition in the UK to expand the field in terms of research, clinical trials, commercial interactions, and patient access and create opportunities in the area of personalised medicine. Dr Sosabowski concluded.

The session also heard from Dr Anna Sundlöv, a senior consultant in oncology at Skåne University Hospital in Lund, Sweden, who discussed dosimetry in clinical trials with molecular radiotherapy, examining “what’s in it for patients?”, and Dr Jonathan Gear, Principal Physicist at the Royal Marsden NHS Foundation Trust, who gave a presentation on the potential for personalised treatment with patient-specific dosimetry.
Critical infrastructures: targets of cyberattacks

Some ten years ago, it was unthinkable that virtually all company data was stored in the cloud. Now it’s what almost every company does. However, the increasing complexity of corporate IT infrastructures also comes at a price.

The sheer size and complexity of the systems makes it difficult to keep track of everything that is going on digitally. And this leads to more and more successful cyber-attacks. With all the consequences this entails.

All companies and institutions in Europe have to deal with European regulations such as AVG and GDPR, which must guarantee privacy. Each country may decide for itself what falls under critical infrastructure, but for most that includes healthcare, financial institutions and governments. What counts as critical must comply with all European standards, which are constantly being tightened along the way. The fines for non-compliance are very high and the consequences of a cyberattack can be huge. That is why companies and institutions need to take a preventive approach to secure their IT in order to avoid getting into trouble afterwards. But how do you know exactly what is going on in your company? How can you gain insight into all the systems you have running and what the weak spots are?

Identify and manage

Identify the components of your IT’s digital “attack surfaces” is an important step towards cyber-resilience. This attack surface refers to all the possibilities that an unauthorized user can have to bring in or steal information. To manage and control that, Dutch cybersecurity company Cybersprint B.V. developed the Cybersprint Attack Surface Management platform; a SaaS solution with continuous monitoring of all possible attack surfaces. For example, by entering a brand or company name, the system searches for anything related to that brand name and the vulnerabilities and misconfigurations associated with it.

Sebastiaan Bosman, Product Marketing Manager at Cybersprint, explains: “Our platform maps the individual digital components of an organisation. Let me explain the three main components which make control of the digital attack surface necessary.

1. Digital footprint: Certainly during Covid, online and cloud working has accelerated and systems have become larger and more complex. And so companies are increasingly outsourcing digital-ly. You must therefore take stock of what is housed with third parties. Remember, your company is always responsible for your own data, even if you hire a supplier who makes a mistake, has a leak or whether there has been a successful hacking attempt.

2. Increasing threat: Threats are becoming more frequent and more sophisticated. Ransomware attacks and phishing are a big problem, and they are increasingly starting in the supply chain. A while back this happened, for example, with the Microsoft email exchange. Criminals were able to get into a large software company and send their own piece of malicious software along with its updates. This gave them access to many more companies at once. In addition to securing your own infrastructure, it is therefore also necessary to know exactly where and which third-party software is running so that you can act immediately in the event of an accident.

3. Rules and laws:

Various authorities such as governments and umbrella bodies within sectors are increasingly prescribing how organisations should run their business, for example, by the field of data privacy. Organisations must have control over their own attack surfaces and be able to prove that they know what is going on. If they can, not heavy fines can be issued. At the end of 2020 an ambulance with a patient had to be diverted because of ransomware. The hackers had gotten in by abusing a Citrix environment (at the end of 2019), a major vulnerability had been discovered in this Citrix product. We were on top of this at the time and advised several customers.

Also, the U.S. Department of Homeland Security has issued advisories to highlight the importance of cybersecurity in healthcare (https://info.publicintelligence.net/NCGIC-MedicalDevices.pdf). It might even be so that people die because of ransomware. For instance, in Alabama, USA, a baby might be the first-ever death caused by a ransomware attack. According to the New York Times, there is a lawsuit against a hospital where a newborn baby ended up with severe brain injury. The mother did not receive all necessary tests when admitted to a hospital to deliver her baby because of an ongoing cyberattack. The tests she missed would have shown that the baby’s umbilical cord was wrapped around the fetus’ neck, with eventually caused brain damage. The baby died nine months later.

What we think is important is the way in which all this information is collected. When you, from within your organisation, start making an inventory of the digital assets you have, you only see what you already knew you had. But what if, for example, created subdomains haven’t all been neatly passed on to the IT security team? This creates blind spots which you cannot secure.

That is why our platform works from the outside in, without special access or an imposed IP range in advance – just as an advanced hacker would see it. This way, an organisation always has the most up-to-date information, fully automated and continuous. Also, the assets found are at once scanned for any risks, allowing a security professional to see what is wrong and to prioritise.’

Shadow IT is a big problem

A major and often unrecognised problem in many companies is categories. For example, a certifi- cate is not up-to-date, or a patch is required. In your system you can see the software you are using and whether you need to protect it. We indicate the risks on a scale from A to F. While an “A” is okay, an “F” means that the issue urgently needs to be addressed by the company’s IT department. Step 5 is the management of all data. What should be...
Cybersecurity threat to remote monitoring devices

Remote monitoring devices and pacemakers supporting patients with cardiac conditions such as heart failure could be vulnerable to cybersecurity risks, according to leading expert Dr Tuvia Ben Gal. While acknowledging the overall beneficial effects of such devices, he remains concerned that not enough attention is given to addressing the potential cybersecurity risk.

Major issues are manufacturers often not factoring in cybersecurity, medical guidelines overlooking the matter, and healthcare providers being uninformed about the security risks and unfamiliar with the methods for evaluating those risks, he pointed out during a session at the ESC Digital Summit 2021.

Focusing on telemedicine, monitoring devices, pacemakers, implantable cardioverter-defibrillators (ICDs), cardiac resynchronization therapy (CRT) devices, and left ventricular assist devices (LVADs), he explained that modern communication technologies for the monitoring and management of patients improve outcomes and lower costs. The devices allow for monitoring and assessment of a patient’s condition by both unidirectional data transmission from the patient to the healthcare provider and bidirectional communication features. The latter are designed to facilitate active intervention or electronic manipulation of the device with the aim of improving the clinical condition of the patient. However, bidirectional communication is not yet being applied due to unresolved security issues, since the feature would also open potential gateways for unauthorised access. Dr Ben Gal cautioned: ‘While healthcare providers are aware of the clinical benefits and downsides of medical devices, they are frequently uninformed of the security risks and unfamiliar with the methods for evaluating those risks. As a result, many patients remain uninformed because they rely on information supplied by the medical team.’

Gap in guidelines

Expressing concern that cybersecurity is not addressed in guidelines, Ben Gal posed the question of whether the security risk outweighs the clinical benefit of the device. During the ESC presentation, he outlined what is needed for protection against these security risks to ensure safe telemedicine implementation. These included:

- collaboration between all parties using remote technology;
- awareness of cybersecurity issues in telemedicine among the medical team;
- establishment of institution-wide security standards, such as for data encryption;
- frequent software updates and antivirus data scanning;
- using proper authentication;
- creating and adopting local cybersecurity regulations.

While he acknowledged the role of public video conferencing platforms, especially during the first phase of the pandemic, the IT expert stressed that going forward, only products specifically assigned for healthcare video conferencing with adequate cybersecurity should be used.

To illustrate his point, Ben Gal expanded on devices used to monitor heart failure patients. Covering a range of parameters, such as haemodynamic and clinical data, pulmonary artery and left atrial pressure, bodyweight, and lung water content, these devices transmit captured data to a healthcare centre. This data is potentially vital, he explained, as it can imitate a change in therapy; if, for example, a certain threshold in one of the parameters is crossed. Therefore, the data must be protected, not only from transmission-related corruption, but also ransomware attacks encrypting the medical data and demanding payment to unencrypt the information withheld. Any such damage to the data’s integrity can have serious consequences such as interrupting device performance, impacting patient management and potentially causing harm, Dr Ben Gal pointed out. Manufacturers and companies therefore carry a great responsibility to ensure appropriate security of the monitoring device and should be encouraged to publish data on security tools for open review.

Establishing a (safe) remote kill switch for ICDs

Newer pacemaker models, which can transmit data by unidirectional communication for remote follow-up, are equally vulnerable to cyberattack, the expert cautioned – although he noted that fortunately, no cyberattacks have been reported on pacemaker technology so far.

During the Covid-19 pandemic, another issue has emerged: At a certain point, ICDs must be deactivated for increasingly frail cardiac patients or those developing terminal illness, to prevent the implant from automatically administering dangerous shocks. However, most devices require the patient to be transported to a hospital for the deactivation – a considerable risk, especially for terminally-ill patients. Dr Ben Gal said therefore pointed out the need for remote deactivation functionality of the devices, with strict security procedures in place. ‘New pacemakers should include enhanced cybersecurity properties, enabling bidirectional communication between the patient and the medical team,’ he said.

The benefits outweigh the risks

The expert also stated the need to enhance cybersecurity properties in LVADs, which use bidirectional communication for remote device adjustments to help reduce complications that hospital visits.

While there was a risk of cyberattack, Dr Ben Gal concluded that the benefits these sophisticated devices bring for heart failure patients still significantly outweigh the drawbacks, greatly helping upgrade the quality of care. However, he added: ‘Medical agencies should provide clear regulations for cybersecurity in the manufacturing process of every medical device.’

Dr Tuvia Ben Gal is the director of the Heart Failure Unit of the Cardiology Department at Rabin Medical Center, Petah Tikua, and Tel Aviv University, Israel. He is author of multiple peer-reviewed scientific papers and speaker at many national and international conferences.
AI implementation: Digital pathology switch bears fruit

Fully digitising pathology operations has led to greater efficiency, cost savings, and quicker diagnosis for the Laboratory of Pathology East Netherlands (LabPON). The move, made six years ago, is showing measurable benefits and now, the institution is beginning to explore the potential of deep learning computational pathology algorithms, which might push the efficiency gains even further.

Pathology in North England goes digital

Reaching out across 15 hospitals and a population of six million people, a network established by the National Pathology Imaging Co-operative (NPIC) is an ambitious move to advance digital pathology in the north of England.

The project, led by the Leeds Teaching Hospitals, will see digital pathology services operate across a network of over 20 NHS trusts and 238 pathologists, scanning over 2.4 million images and generating 3 Petabytes of image data per year. In addition, 48 scanners will feed into 50,000 pathology cases at the Leeds Teaching Hospitals, and the introduction of next generation scanners in 2021.

Daljeet Bansal explained that NPIC’s aims are to drive clinical use of digital pathology, create an environment for development and evaluation of AI and support further research and innovation. The project – which involves additional academic and industry partners working with clinicians – includes processing scanners, reporting, storage, data access and research elements and comes with £50 million of investment to fully deploy digital pathology.

Focus on image analysis automation

The network connects the regions of West Yorkshire, Harrogate, York, Hull, and North East England, enabling shared knowledge and procedures as well as research partnerships.

Areas of focus are the development and validation of automated image analysis and AI tools for the diagnosis of cancer with existing exemplars in breast cancer, skin, and lung cancer. ‘Research partnerships in AI diagnostics and clinical trials will be of benefit for patients and the public,’ added Dr Bansal.

The scale-up of the NPIC network will also include two national specialist networks; one in paediatric tumours, the other focusing on bone and soft tissue tumours. ‘This will be a national knowledge and training centre, customised data sets for AI and research, and research partnerships in AI diagnostics and clinical trials,’ the expert went on.

‘Training will be a key component with hands-on workshops and training for pathologists and biomedical scientists, a centre for industry/NHS collaboration, and a multiple scanner platform for research and AI.’

In cooperation with Genomics England, a company of the UK Department of Health and Social Care, NPIC will also create an image library to complement the genomic and clinical data for each patient and develop pathology-genomic correlation. Dr Bansal stressed the importance of the network as the first and largest-scale project in terms of digitisation, calling the project a ‘key element of a national digital pathology vision in the UK.’

She concluded: ‘It will be a platform for many applications: clinical diagnosis, digital pathology and life cycle of AI to establish ourselves as the national digital pathology system platform for use in the NHS and AI research, supporting clinical trials and diagnostic innovation.’ (MN)

NPIC network

Report: Mark Nicholls

Details were outlined to the 8th Digital Pathology and AI Congress in London by Alexi Baidoshvili, Professor of Pathology, who specialises in digital and computational pathology at LabPON. He reported that LabPON had completely digitised its diagnostic routines for clinical cases in July 2015 and has continued to evolve the technology and processes ever since. Additional milestones were the development and introduction of AI software for image analysis in 2018 and a new Image Management System (IMS) in 2021, with further AI development and integration planned for 2022.

In his presentation, the expert discussed the investments necessary to introduce digital pathology. Areas to be considered include flow analysis in the laboratory, storage, scanners, the need for a robust IMS, training of staff, consultation workflows, software and enabling remote working. On average, setting up a laboratory for digital pathology requires at least 1.5 million euros per year, he calculated, with AI systems not included. However, investments might be a bit lower for institutions which already have a robust IT infrastructure in place. ‘It is very important to choose the right software, and he added, pointing out desirable features such as open architecture, integration with commonly used scanner types, robustness, scalability, support for external consultation and – not least – a user-friendly interface.

Lung tissue with Pau-D staining

Safier, happier, more productive

Despite these initial hurdles, Prof Baidoshvili found the benefits from digital pathology to be well worth the effort for LabPON, which handles 55,000 histology, 20,000 cytology, 10,000 molecular and 12,000 immunohistochemistry cases per year. ‘What we have achieved from our investments is high efficiency and quality improvement,’ he said. Working with glass slides is a thing of the past, reducing the burden on logistics, streamlining workflows, and opening new possibilities for external consultations.

Pathologists’ workplaces also saw subsequent improvement, for example in enhanced safety, better service, and more flexibility, continued Baidoshvili. ‘In the future, there will be a move from subjective diagnosis to objective with AI applications.’ He emphasised how streamlined workflows were important in creating a ‘happier workplace’, leading to quicker replies to inquiries, faster and more efficient internal consultations and better support for multidisciplinary teams (MDTs). Digital imaging also facilitated remote consultations, improved access to information and images, and better means to organise education and research.

Data from LabPON backs up these perceived improvements for example, an experienced digital pathologist can diagnose faster via digital methods than with the conventional microscope. Time savings are significant, reported Baidoshvili, reducing the workload of pathologists when releasing time to perform other tasks, such as participation in multi-disciplinary meetings. The expert noted that all staff segments benefit from this; lab personnel, technicians, and pathologists. Additionally, the switch from subjective to objective diagnosis led to savings on immunohistochemistry, improved service delivery to the clinic and patient, and yielded financial advantages. ‘The digital transition saves on archive time and the work of secretaries and of technicians,’ he added.

Current and future AI benefits

After transition to digital diagnosis, and the seamless integration of interoperable AI, Baidoshvili noted an ‘impressive’ accuracy of the system, for example in cancer detection and Gleason grading of cases. Referencing the lab’s experience with prostate AI solutions Concentrion from Procys and Galien from Inovex, he praised their seamless and intuitive workflows, with initial results showing the potential to reduce immunohistochemistry costs, subject to further validation.

The expert also pointed out the potential of automatic report generation with AI assistance. ‘Thanks to AI, we can save 1.18 million imaging time in every colon diagnosis,’ he said. Applying this to the 500+ cases LabPON processed in 2020, Baidoshvili calculated more than 11 hours of saved diagnosis time for pathologists.

Overall, the switch to digitisation had widespread benefits with much improved logistics, handy tools in IMS resulting in high efficiency, flexible and remote working, easy access to digital archives, better and more efficient diagnostic quality and improved diagnostic logistics, helping to be a happier pathology workforce.

Dr Daljeet Bansal

Director of NPIC (National Pathology Imaging Co-operative), overseeing the NPIC network that will also develop artificial intelligence tools to help diagnose cancer and other diseases.

Reaching out across 15 hospitals and a population of six million people, a network established by the National Pathology Imaging Co-operative (NPIC) is an ambitious move to advance digital pathology in the north of England.
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The rocky (but worthwhile) road to digital pathology

Close liaison between pathologists and data scientists is pivotal in the successful introduction of digital pathology and artificial intelligence (AI) into clinical workflows, according to Professor of France’s leading pioneers in the field.

Professor Catherine Guettier outlined the advantages of digital pathology to the 8th Digital Pathology and AI Congress in London at the beginning of December, but also highlighted obstacles and difficulties, particularly when coupling AI projects with the transition process.

She discussed the experiences of creating a single department of digital pathology for three hospitals in the Saclay University hospital group in Paris – a transition in which it was important to acknowledge the demands placed on data scientists.

For many pathologists, the transition towards digital pathology and AI is marked with mixed feelings, Guettier observed. The Professor of Pathology at Paris-Saclay University and Head of the Department of Pathology at the Hôpitaux Universitaires Paris-Sud illustrated the challenges of this process by example of her department in her presentation ‘Artificial Intelligence and the pathologist’. Main topics of the session were the work with data scientists, and the new role of digital slides in healthcare data. ‘Pathologists’ expectations include screening of lesion patterns in frequent samples, quantification of tumour cells, mitosis count, automated scoring of cancers, quantification of cellular biomarkers and also beyond the usual task of the pathologist, prognostic, theranostic or molecular prediction,’ Guettier also pointed out the difficulties data scientists face, such as the large dimension of digital slides; difficulties to obtain large enough, balanced datasets; pre-analytic variability; and the issue of interpretability.

The meeting of two worlds
Looking at the practicalities of creating a single department of pathology for the Saclay University hospital group, the expert explained how AI projects have been integrated into the transformation process. ‘I am convinced most pathologists will be using AI in their practices,’ she said. ‘But this is the meeting of the two worlds: of the pathologist and the data scientist.’

The new digital pathology network covers three hospitals in Paris, with a shift in focus from teaching to full digital pathology in the workflow. In this constellation, AI has become an important component from the outset. Implementation of the new automation possibilities, for example in quantification of epithelial nerve fibres; screening of prostate and breast cancer foci; and screening of colonic polyps.

Some of the difficulties and obstacles in implementing AI arise from the fact that, currently, very few pathology departments in France are digital. Issues range from lack of compatibility in digital slide sharing between hospitals; different AI companies or academic structures, to regulation issues, medical time for annotation, and GDPR constraints. Prof Guettier said: ‘Digital pathology requires the participation of the pathologist – and many pathologists are already participating – but challenges remain in implementation of AI algorithms into routine workflow.’

High investment, high benefits
As the impact of AI in pathology is yet not clear, implementation of the technology is still lacking a viable business model. This means that managers and pathologists need to work closely to define financially acceptable solutions for the hospital, the expert explained.

This aspect should not be underestimated, Guettier pointed out, because the inclusion of AI comes with the need for considerable investments. Solutions to tackle the 30,000 cases per year are priced around the million-euro-mark, with an additional 100,000 euros for maintenance, software upgrades and an imaging engineer. However, these expenses must be carefully weighed against the expected benefits of AI in pathology, especially time savings and improved diagnostic quality. ‘These benefits include sparing technician time for distribution of glass slides, cost savings on microscopes and glass slide storage, earlier and faster second opinion requests, and productivity improvement through organisation of pathology labs and telework,’ the expert said. ‘The role of the pathologist in this is to guide the choice of algorithms to be deployed, to provide annotated digital slides, to clinically validate algorithms, to test the implementation of AI algorithms in the digital workflow, and to be customers of AI companies’, she concluded. (MN)

Methodology: From image labeling to model deployment (TribunHealth)

The future of pathology is digital – for many departments, the transformation requires major modifications but promises significant advantages. Speaking to the 8th Digital Pathology and AI Congress in London, Professor Catarina Eloy outlined the vital elements for successful transformation towards full digital pathology implementation.

For her presentation, the expert shared insights from the successful and effective introduction of digital pathology at her own institution; the Institute of Molecular Pathology and Immunology of the University of Porto (IPATIMUP) in Portugal. The efforts, though considerable, had led to a ‘new standard for primary histological diagnosis’ and ‘a relevant improvement in healthcare,’ she emphasised.

Highlighting the importance of adopting a new approach, with a focus on workstations and workflow within the implementation process, Prof Eloy said: ‘Digital transformation for primary diagnosis has to be a holistic concept that complements innovative interventions in all areas of the pathology laboratory.’ To create optimal pre-analytic conditions of the sample, optimisation, and automation of the lab workflow with strict quality control and validation policies and operations centres on the LIS (Laboratory Information System) are critical, she elaborated.

Getting started
Digital pathology, while being a cost-effective model with significant, direct, and parallel achievements, must be backed by a safe and efficient methodology, Professor Eloy stated, referring to the initial stages of the four-year digital transformation process at IPATIMUP in 2016. First steps involved optimisation of scanners, workstations, and workflows as well as re-design of the lab layout with an assessment area. ‘All areas converge to the scanning area which is located in the heart of the lab,’ she said. ‘This required some extensive reorganisation of space. The tracking system was probability the most relevant measure we adopted through these first years to have a good digital pathology workflow.’

Once fully digital and paper-free, the laboratory retained the same turnaround times with everything standardised to ensure no errors or lost specimens, Prof Eloy reported. A key ingredient for the successful digitisation of the department was the involvement of the whole team, particularly in the training of technicians and pathologists, along with improvements and automation of the pathologist and technician workflows in terms of equipment, environment, ergonomics, space and workload management. The team at IPATIMUP consists of 14 pathologists (with six not using digital pathology), 11 technicians and five administrative staff, working on 38,000 samples a year with a turnaround time of two days and no fall in quality of diagnosis, the expert said.

The road to AI implementation
The next big step for the department is the implementation of artificial intelligence (AI) to assist in routine workflow challenges. Professor Eloy detailed the roadmap of the process, showcasing a paper from her department. Its mission statement reads as follows: ‘The model of digital workflow implementation at IPATIMUP demonstrates that careful planning and adoption of simple measures related to time, spaces, and sample management can be adopted by any pathology laboratory to achieve higher quality and easy digital transformation.’

In summary, Professor Eloy told the congress ‘After understanding how simple it may be to increase efficiency, quality, and safety in the laboratory workflow, there is not a single reason that justifies delaying in the adoption of the digital management of the pathology laboratory, since it leads to a relevant improvement in healthcare.’
ECR 2022 is building bridges

This year’s European Congress of Radiology (ECR 2022) consists of two parts—an online warm-up event on March 2-6 and the actual onsite congress in July. Multidisciplinarity and interactivity are cornerstones of both events. “Building Bridges” will be the theme of this year’s ECR. “This represents my vision for the future of radiology,” Professor Regina Beets-Tan, president of the congress, explains to Michael Krassnitzer and Tan, president of the congress, “a congress from and for radiologists, but a convention where radiologists can learn from other disciplines. Professor Beets-Tan has invited over 100 speakers from various disciplines. ‘I believe if we team up, we can improve our performance and ultimately increase the outcome for the patients,’ she emphasises.

Multidisciplinarity, however, is only one cornerstone of the upcoming ECR 2022. Another priority is interactivity. The number of parallel tracks was reduced and the lectures were shortened to give room for discussions. ‘Quality above quantity,’ Professor Beets-Tan summarises. There will be sessions with speakers from several disciplines discussing cases just like in daily practice. Instead of sitting in a classroom and listening to the teachers, the participants will interact with the speakers; the president explains. Onsite, there will also be low-threshold ‘open forums’ outside the rooms where the audience can listen to speakers and engage in lively discussions. At ECR 2022, a lot of other new features will be tried out, for example the industry partners will get more space in the congress centre itself in addition to the exhibition hall. ‘ECR is continuously adapting to the changing world. It is certain that after Covid-19 ECR will not be the same as before; it will be a congress of the modern times, yet not less exciting,’ Professor Beets-Tan is convinced.

The most obvious change of the annual congress are the two separate events: the ECR 2022 on July 13-17 in Vienna and the so-called ECR 2022 Overture online on March 2-6, at ECR’s usual pre-Covid-19 date. The warm-up event in March will feature a series of trailer sessions offering a glimpse of some of the major highlights to be held at ECR 2022. In addition, there will be a scientific and educational programme, round table sessions streamed live from a studio with presentations by radiology leaders and industry partners as well a studio dedicated to interventional education and technology. The actual ECR 2022 in Vienna in July will heed the calls for a return to the congress format with opportunities for a more personal exchange of knowledge as Professor Beets-Tan says: ‘Nothing compares to an onsite experience.’

PET/MRI offers significant benefits for cancer patients

PET/MRI is offering new imaging opportunities for cancer patients at various points along the care pathway with its ability to assess different biological processes and its increased specificity.

Report: Mark Nicholls

The growing clinical role of the hybrid modality was discussed by Professor Vicky Goh during the Sir Godfrey Hounsfield lecture at the British Institute of Radiology virtual annual conference in November. In her presentation, Professor Goh highlighted the benefits of the combination, but also acknowledged significant challenges.

Professor Goh outlined how early evidence has established that PET/MRI using the radiotracer 18F-fluorodeoxyglucose (FDG) is non-inferior to PET/CT. ‘Over the last two decades there have been significant strides toward personalised cancer care to improve cancer outcome,’ she said. ‘But in order to ensure that patients receive the best treatment at the right time, imaging has had to evolve to meet these needs. The introduction of clinical PET/MRI in 2010 has been another step change in terms of imaging capabilities for personalised cancer care.’

More than the sum of its parts

The imaging expert pointed out the key advantages of integrated PET/MRI systems: the high sensitivity and the ability to provide molecular information from PET, combined with the high contrast-to-noise-ratio and spatial anatomical resolution that MR imaging offers. ‘These strengths, she added, make PET/MRI a comprehensive and powerful tool for tumour phenotyping. Furthermore, with PET/MRI, physiological imaging such as vascularity, oxygenation or diffusion can be easily integrated with anatomical sequences.’

Continued on page 8

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Precision, speed and simplicity of use. Safety for patient and X-ray technician. Reduced total cost of ownership. These are the benefits of the first Multi-Scan Body CBCT developed by NewTom.

Suitable for radiologists and orthopaedic, otolaryngology and dentistry specialists, NewTom 7G lets you capture accurate information on bone tissues – micro-structures included – to gain an in-depth understanding of the overall clinical picture. Compared to conventional procedures, the system optimises analysis of treatment outcomes (by using low X-ray doses, always in proportion to build) and lowers costs. Automatisms optimise workflows and avoid the variability and uncertainty inherent in manual examination control, especially during patient positioning and actual exposure.

From in-depth detail to the big picture

With the arrival of 7G, NewTom Cone Beam technology examinations can be carried out on all areas of the body, including the spine, shoulder, and hip. System functions and automatisms adapt FOVs and X-ray doses to the patient’s build (especially those of paediatric age). From a minimum of 4x4 cm to a maximum diameter of 29 cm, and a length that can be extended up to 62 cm, adaptive FOVs let users examine the area of interest or a portion of it. A resolution of up to 90 µm means small complex structures such as the inner ear can be analysed with precision.

Select the most suitable FOVs, also for large anatomical areas

NewTom 7G system automatisms allow for acquisition of an extended FOV on the horizontal plane. Developed to acquire bilateral hip images, the NewTom 7G can capture a 40x17 cm FOV. The horizontally extended FOV allows comparative assessment of hip bones via reconstruction into a single volume. The acquisition will therefore show a single volume on which users can modify the display plane to better adapt to clinical needs. NewTom 7G allows the acquisition of extended FOVs on the vertical (longitudinal) plane too. The length of the extended FOVs on this plane can be modulated: users can therefore select FOVs with lengths from 22 cm up to 62 cm.

Extended FOVs allow better morphological assessment of long bones and extensive bone structures (e.g. spine).

Wide gantry and motor-driven patient table

In addition to a 77 cm gantry, the 7G can accommodate very heavy patients thanks to a bed with a load-bearing capacity of up to 215 kg. Lying-down patient positioning ensures simple, accurate alignment of the FOVs and makes results more certain by weighing X-ray exposure.

Broader diagnostic range

The NewTom 7G can perform numerous types of investigation, including those with intra-articular contrast agents (e.g. arthro-grams with Gine-Scout positioning). A broad series of exams with dedicated protocols is available for all disciplines:

- Orthopaedics – osteo-articular study with multiplanar view
- Otorhinolaryngology – ear and airways volume analysis
- Dentistry, implant and orthognathic surgery – dental-maxillo-facial and bilateral TMJ analysis

For further information: www.newton.it/en/medscale/

Benefits in staging and restaging

Professor Goh emphasised the clear benefits of lower radiation dose by replacing CT with MRI, particularly in paediatric or young adult populations, where reductions of 50–80% can be achieved. MRI can also outperform CT in localising the PET signal, and the integration of PET and MRI results in increased specificity and improved quantitation. Due to these benefits, PET/MRI has become increasingly established across the clinical pathway in oncology in terms of detection, characterisation, stage and risk stratification, therapy planning and therapy assessment over the last decade. In particular, the use of PET/MRI in detection and characterisation for prostate cancer has been a success story, the expert reported.

The hybrid modality has also proven its worth in staging or restaging for several tumour types, including gynaecological cancers, resulting in greater accuracy and diagnostic confidence. This versatility has been certified in five studies, which assessed the performance of FDG for primary staging and found that PET/MRI enhances local regional staging and therapy planning. Professor Goh added. For suspect recurrence, PET/MRI has been shown to offer greater diagnostic accuracy and diagnostic confidence, particularly for nodal disease.

Further studies have highlighted the superiority of PET/MRI in detecting, localising and characterising bone and liver metastases. Additionally, the technique can improve patient selection for therapy, such as for neuroendocrine tumours. ‘A number of studies have also shown the added value for PET/MRI in terms of sensitivity for disease and better characterisation of lesions,’ said Professor Goh.

With respect to therapy assessment, she suggested PET/MRI may have a role in clinical trials, while its advantages also apply in some clinical scenarios, for example in the evaluation of myeloma patients undergoing induction chemotherapy and stem cell transplantation. The expert attested to the emerging clinical impact of PET/MRI, referencing two recent prospective studies with different traces, which demonstrated higher accuracies as well as a change in management due to additional findings. Beyond oncology, PET/MRI has also made its way into the clinical routines in neurology and cardiology, Professor Goh reported.

A more expensive option (that still pays off in the end)

While PET/MRI may be more expensive than PET/CT, the imaging expert believes that the benefits outweigh the increased costs: higher overall image quality may obviate the need for additional scans and lead to faster management decisions. Regarding the financial impact, treatment costs may even be reduced due to better patient selection for therapies.

Professor Goh concluded: ‘With increasing personalisation of care, PET/MRI offers the opportunity to transform care delivery for patients and, in particular, to improve patient experience.’
Together, working for your health.

Together, society is working to overcome the healthcare challenge of a generation. But with this challenge comes the opportunity of a new era for healthcare. As we move into this new era, FUJIFILM Europe welcomes Hitachi’s European diagnostic imaging-related medical business to launch FUJIFILM Healthcare Europe. Together, our mission is to help improve the accuracy of diagnosis and support earlier detection of disease. Together, we will never stop in our efforts to create and innovate for a healthier world.
CT severity score predicts Covid-19 death risk

Radiologists at the Hôpital Européen Georges-Pompidou in Paris have developed a standardised visual lung damage CT severity score for Covid-19 patients who do not have symptoms of severe acute respiratory syndrome (SARS) at the time of initial treatment.

This visual score of lung alveolar opacity aids in decision-making to admit a patient into the hospital rather than treating them and sending them home to recover, and to admit inpatients to an intensive care unit (ICU) directly or upgrade them to survivors. Additionally, the presence of pleural effusion and of peripheral distribution of lesions was more frequent in non-survivors.

The researchers compared the severity score with hospital outcomes. Patients with a CT severity score of 7 or higher were also twice as likely to be transferred to an ICU during hospitalisation. Survivors with high scores also had longer hospital stays.

The total CT severity score combining GGO and consolidation was a mean of 6.5 in survivors and 9.5 in non-survivors. The 30-day mortality increased threefold if the visual lung damage CT score was 7 or greater. The more frequent and significant features in non-survivors were dyspnoea (shortness of breath), higher respiratory rate, and lower oxygen saturation.

The researchers reported that there was a significant increase in creatinine levels, in cardiac biomarkers and in inflammation biomarkers in non-survivors compared to survivors. Additionally, the presence of pleural effusion and of peripheral distribution of lesions was more frequent in non-survivors.

The researchers explained that to evaluate prognosis, the short-term mortality seems to us as a more objective criterion than a composite endpoint including mortality. Given the magnitude of the epidemic from one location to another, at near-peak the number of patients transferred to intensive care and conversely sent home were more complex to analyse because of the obvious lack of available space in many institutions, particularly regarding ICUs.

“We have confirmed here that the proportion of patients discharged was lower and that transfers to the ICUs were greater when the lung severity CT score on admission was >7,” they added.

Writing in European Radiology, the authors recommend that their score should be incorporated into risk stratification algorithms and in structured chest CT reports requiring a standardised reading by radiologists. Mousseaux also advises that the severity score also accurately predicts Covid-19-related deaths six months following initial treatment.

The number of lung lobes involved per patient by GGO or consolidation opacities is also estimated as a first visual CT score to assess the extent of the damage. A score of 0, 1, 2, 3, 4, or higher is the threshold indicating greater risk of death within 30 days from Covid-19.

Independent of other commonly accepted risk factors, including patient age, respiratory rate, oxygen saturation levels, comorbidities, and hs-troponin I level at admission. The score also helps predict discharge rates among inpatients.

The researchers analysed rates of all-cause mortality at 30 days according to the number of affected lung lobes by either GGO, consolidation, or both, and according to the visual lung damage CT score. All of the patients were initially admitted to Covid-19 wards, but 7.2% patients were transferred to an ICU during their hospital stay. As of May 8, 2020, when follow-up ended, 147 had been discharged, 15 remained hospitalised, and 48 died.

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Experts discuss gender issues

Women in interventional radiology take center stage

Gender-specific benefits of women should have a greater impact in interventional radiology (IR). But also, the field should see more women practicing the craft.

These were among the main take-home messages of the annual meeting of the French Society of Radiology (SPR). Speakers focused on the benefits brought by IR to women's health and the global shortage of women interventional radiologists.

Interventional radiology offers significant benefits in the treatment of infertility, post-partum issues and symptomatic uterine fibroids, reported Professor Maureen Kohi, chair of the radiology department at the University of North Carolina in Chapel Hill, USA.

According to recent figures, infertility is a global problem that affects 15% of couples trying to conceive. Roughly a third of cases are caused by diseases concerning the fallopian tube. IR can help many of these couples procreate, Kohi explained: "To 25% of tubal disease are due to proximal tubal occlusion," she said. "Fallopian tube recanalisation is an effective treatment that can be provided in a minimally invasive fashion to address this problem." Recanalisation is less aggressive than surgery and may help women avoid potential emotional turmoil caused by other options like in vitro fertilisation, adoption, or surrogacy, Kohi noted.

Saving a woman's life

Another important issue is the high number of women who die while giving birth, often caused by post-partum haemorrhage. Here, uterine artery embolisation (UAE) has proven an effective treatment option. "When you see a pseudoanurysm or some sort of uterine artery anomaly, going ahead and performing a uterine angiography and embolisation can be an amazing way of saving a woman's uterus and her potential for getting pregnant in the future," the expert said. Success rate with UAE in post-partum bleeding is well above the 90% threshold, Kohi reported, with delayed treatment being the most common cause for failure. "The key is having better communication with the obstetrics haemorrhage team and tell the obstetricians to call as soon as possible to improve patient prognosis." Morbidly adherent placenta, another abnormal condition after birth, has increased over the last decade. Patients quickly lose a lot of blood, with 40% requiring more than ten units of packed blood cells – a quantity that many hospitals are not able to provide. Different solutions exist to manage this condition, but most recommendations point to a caesarean, followed by hysterectomy. Catheterisation helps reduce blood loss during those complex interventions, Kohi explained. "We can place occlusion balloon catheters before or after delivery to minimise blood loss during hysterec tomy," she said. However, the procedure exposes the foetus to radiation and is subject to controversial discussion. Kohi performed a registry study to assess the outcomes of balloon occlusion. She found the procedure was associated with decreased estimated blood loss (EBL), transfusions, ICU admissions and adverse events compared to internal artery ligation or no adjunctive interventions.

Bilateral uterine embolisation can also be performed after caesarean delivery and before hysterectomy whenever a hybrid OR is available. Embolisation is also highly recommended in the treatment of symptomatic uterine fibroids, the most common reason for hysterectomy in the US. "It's a great treatment and it's been tested with excellent level of evidence and over time," she concluded.

Underrepresentation of women

Tackling another aspect, Rana Tarek Khafagy, an IR consultant at Ain Shams University Hospital in Cairo, Egypt, highlighted the global shortage of female interventional radiologists. "Although the prevalence of women in radiology has increased over the past few decades, there's still a remarkable lack of women interventional radiologists all over the world," said Khafagy. She also described the situation in Egypt, where female physicians have traditionally been underrepresented, at a current 5.9% of IR consultants. "There's been interest in growing for the past few years," said the expert. Radiation exposure and its potential consequences on pregnancy were identified among the main impediments to a career in IR, along with the nature of the profession and its associated stress, she said. "We should now address those concerns and insist that interventional radiology can be practiced safely," she concluded (MB).

Femored provides support for everyday radiology work

Safe and hygienic: ‘Get up’

Whether in magnetic resonance imaging (MRI), computed tomography (CT), diagnostic radiology, or radiation therapy: in radiology, it’s all about the details. Highly specialised equipment in a professional environment helps to make exact diagnoses and implement precise therapies. Everything else needs to be just as professional.

We at Femored can help with daily operations with the ‘Get up’ handle system. With our handle system, patients can perfectly position themselves on the examination table at their own pace. This takes the pressure off medical personnel, letting them concentrate on what’s essential: the examination.

Reducing workload

In radiology, a large section of patients have restricted mobility, something that can often present a considerable strain for medical staff. They have to use their full physical strength to move patients – and are in danger of becoming a medical emergency themselves. But besides the physical complaints, there are also costs for the employer and the social system. ‘Get up’ by Femored helps reduce this strain in day to day work to a minimum.

Safety isn’t just a handling issue; everything has also been carefully considered in terms of hygiene. The ‘Get up’ handle system by Femored is easy to disinfect and meets the highest hygienic requirements of a medical environment. The material is extremely durable, an investment in safety, but also in cost efficiency.

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Spinal trauma imaging is considered one of the most challenging areas radiologists face as they seek to assess the extent of injuries to patients under high pressure. The issue was highlighted by Professor Dick in her presentation "Watch your back! – an approach to spinal imaging in trauma." Professor Dick explored imaging of thoracolumbar and cervical spine injuries. One of the major challenges, she said, was assessment of the spine's stability, a crucial prerequisite for safe removal of the cervical collar. Misjudging stability can result in severe consequences, such as progression of skeletal deformation or neurological injury.

For many clinicians, the Denis system is the preferred option, based on its division of the vertical body into anterior, middle, and posterior columns. However, if two columns are injured, it is quite likely that the patient has an unstable spine. Professor Dick also outlined the TLICS (Thoracolumbar Injury Classification and Severity) score for determinants of injury covering fracture morphology, integrity of the posterior ligamentous complex, and the neurological status of the patient. It is useful to be aware of this in two out of the three components are based on radiology, she added. Furthermore, she stressed the importance of early imaging for patients with thoracolumbar spine injuries, with CT being the primary modality, followed by MR whole spine imaging.

For patients with cervical spine injuries, Professor Dick advised moving from the anterior to posterior during the examination. Additionally, routine CT in major trauma should be chosen over plain film, with imaging of the entire cervical spine in all planes being of great importance as well. In major trauma in general, a routine whole-body protocol should be performed to image the entire patient each time, she said. 'That way, all the injuries will be included, and the image can be reviewed in a very structured and disciplined fashion, to maximise chances of picking up every injury.'

Professor Dick also outlined the importance in recent years of the posterior ligamentous complex. Consisting of the posterior bony ring and adjacent soft tissues, the structure acts like a tension band which holds the whole spine together, the expert explained. For this reason, injury to the ligamentous complex is associated with a high risk of spinal instability.

The four thoracolumbar spinal injury patterns are:
1. Compression fracture
2. Burst fracture, which may be a flexion-distraction or Chance fracture, an unstable three-column injury which may have an associated abdominal injury, and usually needs intervention
3. Fracture dislocation, such as from someone falling from height, with unstable spine and a high likelihood of neurological deficit

Professor Dick added: 'Burst fractures can be stable or unstable. If a patient has a neurological deficit, that would indicate the need for surgery. The radiologist can help by identifying various signs on CT, such as severe loss of height of the vertical body, retropulsion, kyphosis and rotational malalignment.'

Another aspect that has gained relevance in recent years is the posterior ligamentous complex. Consisting of the posterior bony ring and adjacent soft tissues, the structure acts like a tension band which holds the whole spine together, the expert explained. For this reason, injury to the ligamentous complex is associated with a high risk of spinal instability.

For children, different rules apply. For patients with cervical spine injuries, Professor Dick advised moving from the anterior to posterior during the examination. Additionally, routine CT in major trauma should be chosen over plain film, with imaging of the entire cervical spine in all planes being of great importance as well. In major trauma in general, a routine whole-body protocol should be performed to image the entire patient each time, she said. 'That way, all the injuries will be included, and the image can be reviewed in a very structured and disciplined fashion, to maximise chances of picking up every injury.'

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In the second year of the pandemic, JVCKenwood draws a positive conclusion despite all difficulties. ‘We were able to welcome some highlights in 2021, both on the part of new monitors and new customers,’ says Marcel Herrmann, Marketing Manager Medical Imaging. ‘Nevertheless, the situation remains tense here and there.’

The two new displays CL-S600 and CL-S1200 have received consistently positive reactions from users. Both can display medical images of different modalities such as CT, CR/DIR, MR ultrasound and pathology side by side, the 12-megapixel monitor additionally displaying images of mammography. The two large screens without a centre bar create a comfortable environment for radiological diagnostics. For this purpose, they are equipped with the latest technology. The patented Dynamic Gamma function, for example, analyses the entire screen content and selects the correct gamma curve for each individual pixel in real time. This applies to all images – whether ultrasound, endoscopy, pathology or nuclear medicine – and always results in an optimal display,’ explains Herrmann. This succeeds without problems even with moving images, although millions of operations per second are necessary here. Another important feature: luminance and colour temperature are adjusted automatically and in real time. ‘The built-in colour front sensor on the screen constantly measures the colour temperature and adjusts changes over a long period of time,’ says Herrmann. This is easy on the eyes of the person making the findings – as is the built-in lighting on the back of the monitor and the indirect lighting of the keyboard and monitor backside.

JVCKenwood has installed the first CL-S1200s in a hospital in Switzerland. Spain also reports a large project: Here, the Japanese company has equipped all clinics in the Asturias region around Gijon.
Effective treatment of stroke depends critically on workflow and the overall strategy for how patients are evaluated and treated, the Chairman of the Department of Radiology and Biomedical Imaging at the University of California, San Francisco (UCSF), said. For Hess, new and emerging multimodality angiography suites that include MRI and cone-beam CT hold significant promise for stroke patients. ‘We have a closely located MRI and angiography suite at Zuckerberg San Francisco General Hospital that we use to decide in real-time how to process with embolotherapy. Our other imaging resources like effective hub-and-spoke imaging transfer tools, fast emergency department CT and cone-beam CT in the angiography suite are essential to rapidly make sure the patient doesn’t have a hemorrhage before embolotherapy proceeds,’ he reported.

This technological advantage directly affects workflow at UCSF because it can allow patients with large vessel occlusion to avoid going through the ER, the expert explained. ‘Patients are transferred directly into the hands of our neurointerventionalists to start the procedure. ‘This is important, because the clock is always ticking in stroke therapy.’ Time is also of the essence when thrombolyis is performed using tissue plasminogen activator (tPA) in patients with large-vessel occlusion. The tPA protein, which is used to dissolve the clot, must be given intravenously within a four-and-a-half-hour window from the onset of symptoms to ensure treatment success.

Mobile Stroke Units Deployment of Mobile Stroke Units (MSUs) is another approach to shorten stroke-to-embolotherapy time. Equipped with compact CT scanners, point-of-care laboratories, and real-time bidirectional audio-video communications, these ambulances allow for initial diagnostics and even treatment while the patient is on the way to the hospital. Clinical staff onboard typically include a paramedic, CT technologist, and physician plus a registered nurse trained in stroke medicine. Researchers at the Medical University of South Carolina recently tested an ultra-low field portable MRI machine that would not only cost a fraction of the CT scanner but would also bring the advantages of MRI scanning to the MSUs.

‘Mobile Stroke Units offer significant promise. Studies show that they improve patients’ outcomes by decreasing the time to treatment,’ Hess said. ‘However, with costs often exceeding $1 million per unit, MSUs are a very expensive resource to deploy and their overall effectiveness remains to be determined. It is critical that these resources are directed to actual stroke patients, and not in circumstances where other neurological disorders like seizures, headaches or drug overdoses cause stroke-like symptoms.’ Embodica is available at only a few centres, so the distinction between stroke and stroke-like syndromes impacts where the MSU should drive. ‘We have to see how effective it is at triage, but I expect that for large vessel strokes, MRI in MSUs will be very effective and cost-efficient,’ Hess said. ‘Especially with late-onset strokes, the question often is how much tissue is still viable. The extent of whether an MRI scanner could answer that question prior to the arrival at the hospital would allow a more precise targeting of therapy,’ he explained.

Outlook Envisioning the future of stroke imaging, for Hess, it all boils down to workflow. ‘The future lies with multimodality systems. At UCSF, we are very excited about our combined angiography-MRI units and using them to make real-time decisions about how to best treat patients,’ Hess said. ‘We need to push for more multimodality imaging.’ Furthermore, he envisions new software will help the diagnosis and treatment of stroke. ‘There will be advances in numerical quantification of a stroke’s effect on the brain, some of which use MRI, and these will increase our ability to more effectively select patients who will benefit from treatment,’ he predicted.

When a patient suffers a stroke, speed in treatment can mean the difference between successful recovery, permanent disability, or death. Often encapsulated in the phrase ‘time equals brain’, the ability to act quickly and with greater certainty enables physicians to bring a higher quality of life for those who survive. For Christopher Hess, MD, PhD, success in stroke diagnosis and impactful treatment therefore is a question of workflow and efficient care delivery.

The use of CT angiograms may also be considered to identify injury of the vertebral artery early, so patients can be anticoagulated to decrease the risk of stroke. However, the aforementioned guidelines only apply for adult patients, Professor Dick cautioned, as the rules on imaging the spine in children are very different: if possible, CT imaging should be avoided because of the long-term radiation risk and should only be considered if there is a strong suspicion of injury.

with more than 400 different displays.

Innovations for 2022

2022 will be marked by functional expansions of the i5 monitors. They will also be equipped with a turboluminance function as well as the so-called Visual Point Mode, which users of our 6 and 12 MP displays are already familiar with,” says Herrmann. The turbo luminance function can increase the brightness and contrast of the screen for a maximum of 50 seconds to magnify recognizable greyscale details. This enables the radiologist to reliably assess even the finest calcifications. The effect is further enhanced by the Visual Point mode. This increases the contrast in certain areas controlled by the mouse pointer. With both technologies, the DICOM characteristic curve is maintained or dynamically adjusted.

In addition, the launch of an 8-megapixel monitor is planned for the summer. ‘However, due to the long-term radiation risk and should only be considered if there is a strong suspicion of injury.

Christopher Hess,
MD, PhD, is Alexander R. Mangold Professor and Chairman of the Department of Radiology and Biomedical Imaging at the University of California, San Francisco. Hess earned his medical degree at the University of Illinois College of Medicine. He obtained a master’s and a doctorate in electrical engineering at the University of Illinois at Urbana-Champaign working in the field of MRI. His primary research interests lie in brain degeneration, epilepsy, and neurovascular disease.

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www.newtom.it
The robot with a model of an intestine

The device, called the Endoculus, has been designed by a team at the Advanced Medical Technologies Laboratory (AMTL) at the University of Colorado in the United States.

Professor Mark Rentschler, director of the AMTL, who leads the project, explained the current version of the device began in earnest in 2016 with PhD students Greg Formosa and Micah Prendergast advancing the mechanical and electronic design. It has now reached the stage of adding more autonomous capabilities and features to further the understanding of its capabilities as the team look to transition the project into a commercial product that is affordable and tested clinically.

Reducing the strain on endoscopists and patients

The robot is the size of a small film cannister and can be used on patients without causing discomfort, but the team is looking to make it smaller still.

The idea was originally to make a capsule device that can be tethered and can propel itself around to enable remote endoscopy, explained Professor Rentsheller. There are a few things tied to that: one is just capability and ease, but also a lot of the mental energy and effort from surgeons are focused on getting to where they need to go with the scope, rather than just focusing on visualisation. So, if you can have less of a manual approach, the upside for the physician is that they can focus on diagnostics and treatments, not just access. With chronic shoulder and elbow problems being a well-known strain on endoscopists related to this heavy manual work over long periods of time in theatre, this is not just a matter of enhanced convenience.

Endoculus

The 'Endoculus' miniature robot

From push to pull

The device offers benefits to surgeons and patients. ‘The patient benefit is more comfort and less pain,’ Rentsheller said. ‘With endoscopy, dissection in the wall from endoscope pushing is where discomfort occurs for the patient. The key for us is to transition away from

Robotic surgery procedures bring great benefits to cardiac interventions

Interventional cardiology is entering a new era with the wider introduction of robotic procedures which bring significant benefits to the medical team and the patient. The benefits for interventional cardiology were outlined to the ESC 2021 Digital Summit by consultant cardiologist Professor Dariusz Dudek, while cardiac surgeon Professor Nikolaos Bonaros discussed the advances in robotic cardiac surgery.

Relying on robotic assistance benefits precision and brings additional options for remote procedures. This, in turn, results in less direct contact with the patient, and reduced exposure to radiation for interventional cardiologists.

While interventional cardiology and percutaneous coronary interventions (PCI) had seen significant progress in recent years, Professor Dudek, from the Department of Clinical Cardiology and Cardiovascular Interventions at the University Hospital and the Jagiellonian University in Krakow, Poland, expressed his confidence that robotic techniques would take these fields even further, ushering in a new era. Having adopted the technique for patients at his centre in March 2021, he outlined the benefits for the cardiologist, medical team, and the patient.

However, for aspects such as wire manipulation and balloon or stent delivery, robotics also allow for a degree of automation, Professor Dudek explained. ‘The benefits we see is that there is almost no radiation exposure, and a dramatic reduction of operator fatigue due to not having to wear heavy aprons.

Rentschler added. ‘Ultimately, we wanted to approach this as a remote device that the physician can control and get to where they want it to go.’

The group is looking at options to design portions of the device for single use, with motors off board and the power transfer through its tether. ‘We are trying to add new capabilities to the physician suite but not radically change their approach from an operational standpoint,’ the robotic expert added.

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Robotic ‘mini-tank’ to enhance

A miniature colonoscopy robot developed to collect images and biopsies could have clear benefits for both patients and endoscopists. The device, which carries a camera and uses other small surgical tools, uses tank-like treads to proceed along the patient’s colon under the control of a gastroenterologist, instead of the current ‘pushing’ technique to propel the endoscope manually through the colon. This means advantages for the patient in terms of less friction and discomfort, as well as having ergonomic benefits for surgeons.

Laboratory (AMTL) at the University

The Advanced Medical Technologies

has been designed by a team at the University Hospital and the Department of Clinical Cardiology at Innsbruck Medical University, Austria, reflected on advances in robotic cardiac surgery, and developments in techniques, equipment, and instrumentation, over the last two decades. Available systems range from fully human-controlled procedures through partial automation with human back-up, to fully-automated smart vehicles capable of operating in any circumstances, he explained.

For aspects such as wire manipulation and balloon or stent delivery, robotics also allow for a degree of automation, Professor Dudek explained. ‘The benefits we see is that there is almost no radiation exposure, and a dramatic reduction of operator fatigue due to not having to wear heavy aprons.

Dariusz Dudek at the robotic console

The ‘Endoculus’ miniature robot

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More precision, less fatigue

The robotic instruments are controlled via a cockpit console in the operating theatre, the cath lab or a separate control area. Only one assistant is needed close to the patient to change devices and wires with headset communication between the two areas.

For aspects such as wire manipulation and balloon or stent delivery, robotics also allow for a degree of automation, Professor Dudek explained. ‘The benefits we see is that there is almost no radiation exposure, and a dramatic reduction of operator fatigue due to not having to wear heavy aprons.

There is also precise evaluation of coronary artery lesion length, which is much more precise than colleague assessment, and precise positioning of stents, especially for ostial lesions and for long lesions with minimal overlap.

Precision is also increased in comparison with the manual technique, the expert continued, particularly with guidewire navigation. ‘With this technology, it is time to change the traditional cardiology era and make the next step,’ he said.

Professor Dudek envisions the ‘cath lab of the 21st century’ as a step it, with a greater focus on image-based pre-procedural planning via CT, robotic assistance, and the ability for remote procedures.

‘We are going towards a new era that is a paradigm shift in interventional cardiology, with less radiation exposure, artificial intelligence and more precision,’ Professor Bonaros

from Innsbruck Medical University, Austria, reflected on advances in robotic cardiac surgery, and developments in techniques, equipment, and instrumentation, over the last two decades. Available systems range from fully human-controlled procedures through partial automation with human back-up, to fully-automated smart vehicles capable of operating in any circumstances, he explained.

The expert showcased the benefits of automation with examples of cases, demonstrating the degrees of manipulation of the instrument, particularly with the flexibility of the endowrist technology, and levels of 3D visualisation. However, while robotic assistance brings benefits in cardiac surgery procedures
ROBOTIC SURGERY

colonoscopy techniques

push endoscopy where the physician is pushing, to pull endoscopy, where device at the end of the tether is pulling it softly through the colon.

With the surgeon, the reduced physical effort helps avoid common injuries associated with the task.

For populations with a tortuous, or strange, colon pattern, it can be challenging for physicians to reach the cecum at the beginning of the colon to get a full colonoscopy, so consistently getting a complete procedure is also a strong upside for the device, he said.

**From testing to clinical practice**
The device is a few years away from use in clinical practice but has been tested on animal tissue laid out in the form of human anatomy. The plan is to launch a company to establish the product, with a view to procedures in humans within three years. ‘We have focused long and hard on the clinical aspect, but we really need to make sure of the commercialisation aspects of it to keep it moving forward,’ said Professor Rentschler.

The team believes the Endoculus could eventually replace traditional endoscopes used in colonoscopies and endoscopies and lead to earlier detection of cancers enabling better outcomes.

**Introducing Versius®**

Versius fits into virtually any operating room set-up and integrates seamlessly into existing workflows.

Mark Rentschler

Mark Rentschler is Professor of Biomedical, Mechanics of Materials, Robotics and Systems Design and director of the Advanced Medical Technologies Laboratory (AMTL) at the University of Colorado in the United States. His research is focused on intelligent medical devices and surgical robotics for patient-specific medical care and includes design of novel surgical tools, devices, and robotics, and characterisation and modelling of how these interact with the patient.

Dariusz Dudek

Dariusz Dudek is President of the European Association of Percutaneous Cardiovascular Interventions (EAPCI) of the European Society of Cardiology (ESC). He heads the second Department of Clinical Cardiology and Cardiovascular Interventions at the University Hospital in Krakow, Poland, and is a Professor of the Institute of Cardiology at the Jagiellonian University in Krakow. His key areas of research are acute myocardial infarction, antiplatelet and antithrombotic drugs and complex PCI.

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The expert from the Institute of Clinical Chemistry of the University Medical Centre Mannheim, Germany, also outlined the challenges with implementing the technique into standard care and routine diagnostics in management of cancer patients.

Liquid profiling, she says, brings a number of benefits. It can be used as a companion diagnostic for appropriate drug selection, provide therapeutic monitoring to detect upcoming resistance mechanisms and recurrence, and prognosis assessment for guidance of therapeutic/diagnostic decisions. On the other hand, she conceded that it was a challenging type of diagnostics with a need for highly sensitive techniques. Its unwieldy nature made it hard to convince clinicians to integrate it into their clinical routine workflows, despite the benefits, the expert summarised.

‘At the end of the day, the clinicians will decide’

Her unit was the first to introduce an external quality assessment scheme in 2017, which now sees 40 laboratories participating. Compared with standard-of-care molecular genetic tests, liquid profiling is prone to high error rates, often depending on the methods used by individual labs. Prof Haselmann identified further challenges in a lack of harmonisation of preanalytical and analytical workflows and reimbursement issues for most targets. Most important, however, is the interpretation of biological guidelines for different cancers, because ‘at the end of the day, the clinician will conduct this and will be successfully translated into standard of care’. Liquid profiling, the expert maintained, is still not fully implemented into standard of care. But we do see a nice correlation between the frequency we observe in liquid profiling and the clinical course of the disease of the patients. She noted that more clinicians become aware of these benefits and it is increasingly being integrated into workflows. If this trend were to continue, liquid profiling should have a ‘really great future’ to match its diagnostic potential, Prof Haselmann concluded.

Different strategies for different scenarios

Dr Ellen Heitzer from the Institute of Human Genetics at the Medical University of Graz, Austria, discussed the application of liquid profiling diagnostics in oncology and its unique challenges. One of the main drivers of this highly fragmented nature of circulating tumour molecular diagnostics is personalized medicine in cancer at the University of Graz, Austria. A pioneer of liquid biopsy in Europe, her scientific expertise and research focus is in cancer diagnostics, using circulating DNA, tumour heterogeneity, hereditary cancer syndromes, next generation sequencing, and circulating tumour cells.

Emerging technologies in POCT

Considerable advances in point-of-care testing (POCT) devices are emerging from lab-on-a-chip platforms, innovations in smartphone-based technology and wearable technology. Cloud-based deep learning systems herald a future revolution, writes Bernard Bangs, MD.

The World Health Organization (WHO) has endorsed bedside diagnostics as the top research priority in response to the so far 2-year long epidemic without let-up. The aim is to improve turnaround time and ease of use compared to the gold standard lab-based PCR test. These have included rapid antigen tests, alternate nucleic amplification methods and novel sensors in proximity to the patients.

POCT deployed in multiple clinical contexts in 2021

POCT is being rolled out in various healthcare settings in 2021. The most obvious applications are blood-glucose monitoring and pregnancy testing. Widespread POCT testing and diagnostic devices are available, including, but not limited to, glucose monitoring, pregnancy and infertility testing, infectious disease testing, cholesterol testing and cardiac markers, said Amit Saha, from the Stanford Genome Technology Center in California, USA. Today, blood gas analysis along with haemoglobin, prothrombin time and infectious disease testing are the dominant applications in the POCT market.

Looking to the future, tumour markers, flow cytometry (mainly for chemotherapy monitoring), endocrine function tests and therapeutic drug monitoring will all benefit from recent technology advances in the POCT field.

Technology advances change POCT applications

Minaturisation in chip technology, microfluidics and new biosensors have heralded the design of new systems for POCT. Lab-on-a-chip technology is one of the main drivers of POCT, especially in infectious disease diagnosis. This technology means various bioassays, such as microbiological culture, biochemical analysis. They enable detection and fluid regulation in a single unit. ‘Greater sensitivity and specificity when detecting target analytes in small volumes overcomes several challenges encountered when using traditional POCT techniques,’ Saha said. POCT currently centres around two technologies: lateral flow assay (LFA) and nucleic acid amplification. The first is used in pregnancy testing; testing for HIV, herpes simplex virus, hepatitis, infectious diseases (Ebola, dengue, malaria, Zika virus) and respiratory infections; and for diagnostics and prognosis in conditions such as cancer, by identifying specific biomarkers. The second, which is more sensitive and specific, is based on PCR on a chip and isothermal amplification. Nucleic acid amplification can be used to detect a whole array of infectious diseases, such as Mycoplasma pneumoniae, Bordetella pertussis, Legionella pneumonia, Influenza A virus, SARS, Legionella, Aspergillus, West Nile Virus and, now, SARS-CoV-2.

A seventh format joins POCT

POC device manufacturers are continually looking for ways to design products that deliver greater user comfort in a cost-effective manner. POCT relies on six main formats: bench-top, monitoring, transportable, portable, handheld and disposable. In recent years, the latest advances have seen the launch of a seventh: smart devices with smartphones and wearable devices. Mobile POCT uses sensors to detect signals from samples in vitro, whereas wearable POCT detects signals directly on the body. Both systems then send quantified results to the clinic via wireless communication. Various body fluids such as tears, urine, blood, sweat and saliva can be used to analyse metabolites, hormones, proteins, viruses and bacteria.

Smartphones act as minicomputers for sensitive and specific data quantification with built-in sensors, high resolution cameras, rapid wirelessly connected and the ability to use various software and apps. This means they can function as standalone sensors and detectors in mobile POCT. Saha pointed out.
Clinic

DNA (ctDNA), making it hard to discriminate between normal cell-free DNA (cfDNA) and its malignant counterpart.

She also pointed out the need for adapting analysis strategies to different clinical scenarios, while at the time of diagnosis, testing of clinically actionable targets might be sufficient to tailor the patients’ treatment, the detection of MRD (minimal residual disease) after surgery or a molecular relapse requires screening for patient-specific alterations to achieve the necessary sensitivity. To analyse disease progression, larger gene panels and genome-wide analysis of copy number alterations may identify resistance mechanisms or novel actionable targets.

Potential alternative to tissue biopsy

To illustrate this further, Dr. Heitzer applied this approach to non-small cell lung cancer (NSCLC), where hard-to-access tumours are present in 31% of patients and up to one fifth of biopsies yield insufficient tissue quantity or quality for molecular testing. With respect to MRD, she noted that ctDNA could detect disease recurrence earlier than imaging in 72% of patients, adding that ctDNA recurrence opens a window of opportunity to treat patients while tumour burden and heterogeneity are at their lowest.

She also pointed out the role of ctDNA as a marker of treatment response in ICI (immunotherapy) and the high value in diagnostics studies. In addition, ctDNA testing has entered clinical routine in cases where no evidence-based treatment option is left and clinicians look to plasma for clinically-actionable mutations. However, due to the high variability of ctDNA, we still need to work on sensitivity, the expert cautioned. Implementation of ctDNA mutation testing in routine clinical practice is envisioned in the near future, but it is necessary to standardise workflow because many steps are involved in a liquid biopsy test so it is really important to do this in a proper way.

Similarly, wearable POCT devices can be physical sensors used to acquire samples from the skin, eye or mouth with minimal invasion. They come in various forms, such as tattoos, patches, bands, watch-s, spectacles and contact lenses, and can be integrated with smartphones for data capture. This type of testing is especially important for patients suffering from critical conditions, as they can monitor their health constantly without the need to go to hospital, or for trained personnel.

Artificial intelligence and machine learning

Artificial intelligence (AI), machine learning (ML) and neural networks are now starting to be integrated into POCT. These AI modules have demonstrated their value in diagnostics studies. However, the accuracy of test apps varies greatly and relying on these apps is cautioned against. The future is bright. Since samples can be digitised directly at the point of care (POC), advanced digital diagnostic techniques, such as sample analysis using medical AI algorithms, can be deployed outside high-end laboratories. Hence POC digital microscopy, supported by automated digital image analysis and AI, might be deployed for routine microscopy diagnostics on samples harvested during the cancer surgery, or on parasitology samples with an emphasis on potential areas of application in infectious diseases, added Oscar Holmstrom from the Faculty of Medicine at the University of Helsinki.

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More than 15 billion batteries are sent to landfill sites every year – technology that converts glucose and oxygen into electricity has the potential to reduce this waste and serve as a sustainable alternative power source for medical devices such as pacemakers, glucose monitors and pregnancy kits.

Markus Sonderegger, from Austrian company BeFC at the ‘Powering the future – Energy generation with papers and enzymes’ session.

Dr Jules Hammond, CEO of BeFC, described the technology as part of a new wave of smart and connected devices for patient monitoring, glucose monitoring, fertility testing and connected packaging. With an estimate of 50 billion connected units in 2020, this is expected to be a growing market within the industry.

Many of these devices can operate with low power consumption. Dr Hammond proposed that sustainable and clean energy alternatives can be used to power these machines, replacing conventional miniature batteries that often contain toxic materials.

The eco-friendly paper-based fuel cells are ultra-thin, lightweight and flexible. Energy is generated via enzymatic reactions and stored using glucose and oxygen, avoiding the use of toxic materials and environmental pollution long after the batteries have been discarded. The sustainable power cells developed by BeFC are flexible, lightweight and appropriate for wearable and implantable devices, the company’s CEO pointed out. ‘We use enzymes to convert glucose and oxygen into electricity, very much a bioinspired solution.’ The glucose and oxygen can be harvested from the bloodstream and power items such as pacemakers and insulin pumps, with the biofuel cells being activated by biological fluids such as blood, sweat, or urine. Dr Hammond also presented a ‘blister reservoir’ as an alternative mode of activation, with the technology able to last for days or even months, depending on use case. The power source can also be sterilised with no obvious signs of degradation, he pointed out.

‘The fuel cells are constructed as a stack of cellulose and carbon layers. Its function is based on the use of different enzymes immobilised on the electrodes. One enzyme is used to oxidise glucose, liberating electrons, which are harvested through the electrode. A different enzyme then reduces oxygen into water, which pulls electrons through the electrical circuit with the addition of a second half-cell reaction creating the biofuel cell. The device is able to last for days or even months, depending on use case. The power source can also be sterilised with no obvious signs of degradation, he pointed out.’

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Reliable even when the lights go out

The shape and size of the paper biofuel cell can be adjusted or enlarged as necessary. Current models are 600 microns in thickness, with plans to reduce to 250 microns in 2022. Dr Hammond reported that his company is working with partners to scale up their production from a robotic sheet-to-sheet process to a roll-to-roll process.

‘A major obstacle that prevents many green and flexible energy sources from use in wearables is their tendency to produce only unreliable power output. As an example, photovoltaics require exposure to direct light to achieve useful power densities – this makes the technology unsuitable for devices worn underneath garments. Due to their structure, the batteries developed by BeFC are not limited in this way, the CEO pointed out.’

He expressed confidence in the technology developed by his team at BeFC of engineers, scientists and problem-solvers, with academic backgrounds in biosensors, printed batteries and paper microfluidics. ‘What we are looking to do is provide smart and connected devices that represent the minimal environmental amount of impact.’

For the development of the new product, the company has consulted with a medical advisory board and established a cooperation with the University of Vienna. With the product verification and usability phase completed, Dr Jules Hammond is looking forward to the launch of the new battery, which is focused on hiring talent to build an interdisciplinary team of problem-solvers. He develops the strategy to guide the company towards its mission of replacing conventional miniature batteries with eco-friendly technology, to provide a sustainable energy solution for low-power electronics.

The fuel cell is a stack of cellulose and carbon layers. Its function is based on the use of different enzymes immobilised on the electrodes. One enzyme is used to oxidise glucose, liberating electrons, which are harvested through the electrode. A different enzyme then reduces oxygen into water, which pulls electrons through the electrical circuit with the addition of a second half-cell reaction creating the biofuel cell.

BeFC sustainable power source batteries

Smart textiles to help detect heart conditions

Serious heart conditions such as Atrial Fibrillation (AF) are among the major causes for strokes in patients, if undetected. However, AF can be difficult to pinpoint as symptoms – irregular or rapid heart rhythms – may occur at unpredictable intervals. So, long-term monitoring of a patient’s heartbeat is required to effectively identify AF. Smart textiles with built-in sensors and transmitters present themselves as a diagnostic solution as they can monitor heart rhythm over long periods and thus pick up on potential AF.

Risk of stroke is increased 3–5 times for AF patients, but because the condition can occur at irregular intervals, it may remain unnoticed by the affected person, explained Markus Sonderegger, from Austrian start-up company 24sens. Globally, 45 million people have AF, a quarter of 40-year-olds will develop it in their lifetime, and the prevalence increases rapidly with age, with 10% of people over 65 affected.

With more than five million new cases a year,

Wearable device designed for all day use

24sens has devised a mobile solution for long-term 24/7 recording and visualisation of heart rates and certain heart diseases, particularly AF. The system, called SmartcorCONTROL, consists of a smart textile patch, which is fastened via a chest strap, and sensor technology-based software. A sensor located at the front of the strap and an onboard ECG monitor are used to gather data on heart activity over several days. The device is connected to a mobile app, which is used to gather data on heart activity and subsequent analysis of the data.

The SmartcorCONTROL system combines smart textiles with intelligent software.

Control and feedback options for patients

Using the mobile app, patients can pause and resume the recording as well as give feedback on health status and activities during the recording. The application visualises the heart activities and the detection of areas possibly affected by AF, and they can be seen through the doctor’s dashboard; Mr Sonderegger said. ‘The healthcare professional can access important data without reviewing the whole data stream and can provide an earlier, faster and reliable diagnosis.’

For the development of the new product, the company has consulted with a medical advisory board and established a cooperation with the University of Vienna. With the product verification and usability phase completed, Dr Jules Hammond is currently preparing the market launch in line with the new Medical Device Regulations (MDR).
Antibiotic resistance: a global problem in urgent need of intelligent solutions

Antibiotics have been at the heart of modern healthcare since the 1950s. They are prescribed prior to an operation to minimise the risk of infection after the operation. Or antibiotics are prescribed to fight an infection. This practice, which might seem straightforward at first glance, has proven to cause a number of problems itself.

Antibiotic resistance is a major cause of preventable infections, and there are very few last-resort treatments available. Increasingly, bacteria are known to evolve to become resistant to antibiotics, and there are very few last-resort treatments available. Increasingly, bacteria are known to evolve to become resistant to antibiotics, and there are very few last-resort treatments available.

That’s why as academic researchers, we are very concerned about the issue of antibiotic resistance (AMR). We know that some bacteria become resistant because they can produce enzymes that break down antibiotics. We are trying to tackle that problem by developing enzyme inhibitors that prevent bacteria from destroying the antibiotics and thus maintaining their antibacterial activity. Another approach our research team is using to study antibiotic resistance is by structurally modifying antibiotics. In this way, the bacteria are exposed to a "new" antibiotic to which they are not resistant. Now, several years into the research, we are testing how well these modified antibiotics cure infections in animals. This is still the preclinical phase, but the results so far are very encouraging. If we can show that these new antibiotics are safe and effective in animals, the next step is to test them on humans.

Eduardo Martin is convinced that there are more ways to prevent an increasing number of bacteria from developing resistance. For example, educating every prescriber of antibiotics is high on the agenda. In fact, education and communication were the motivations for Molecular/ Medical Microbiologist Maarten van Dongen, PhD, in collaboration with Dutch public and private organisations, to found AMR Insights in 2017. The information platform focuses entirely on combating the issue of antimicrobial resistance worldwide.

‘The subject already had my attention, but when my neighbour died of an infectious disease, and there was no antibiotic that could save him, AMR came awfully close,’ he said. There is a lot of research and information being generated on antimicrobial resistance worldwide. And that amount of information makes it difficult to determine relevance and to keep abreast of the latest developments. While staying on top of current events might be possible with some effort in the Western world, the expert says that this is much more difficult or even impossible in developing countries.

As a major cause of preventable deaths, AMR must be tackled now, Van Dongen stresses. ‘Already each day around 800,000 people worldwide die, and according to the World Bank, AMR leads to extreme poverty in many places.’ To reduce the prevalence of resistant bacteria in countries such as Belgium and Germany, but also in southern Europe, he advises to look to the Netherlands, where AMR is much less common. This is because in the Netherlands, we are cautious about prescribing and using antibiotics in humans and animals, the microbiologist says. He also compli- ments the Dutch open-mindedness for new technologies, citing a type 1 diabetes app as a major inspiration for the AMR Insights platform.

‘When I became involved with the app, I thought that a collection platform with information on antibiotic resistance should be feasible,’ Van Dongen recalls.

About the platform

The online expertise platform AMR Insights informs, educates and connects experts from different disciplines worldwide. Symposia and innovation missions are organised, and people can subscribe to the free newsletters. These contain information for people from different sectors: professionals in the human, animal, food, and environmental sectors can draw on the collected and tailored information to help them in their daily work. Updates on current research, such as the modification of antibiotics, which Martin’s team is working on, are also available on the platform. In addition, more than 300 ambassadors including researchers, doctors, veterinarians and entrepreneurs in some 60 countries work together to represent AMR Insights in the workplace. They are united under the project’s aim of maintaining antibiotic availability and effectiveness as well as preventing AMR from further threatening health and food safety.

Martin sees current antibiotic management in emergency consul- tations as a main driver of AMR. ‘Here, a broad-spectrum antibiotic is often used until it is determined whether an infection is viral or bacterial and, in the latter case, what type of bacteria it is.’ To put an end to this practice, solutions are needed to view and sequence the genome of bacteria more quickly, determining resistance profiles before medication is applied. As progress is made in diagnostics, this should also allow a more targeted approach to the use of antibiotics, he says.

Another cause of resistance development is the widespread use of antibiotics in animals – to prevent disease or just to promote growth, the expert continues. As a result, antibiotics accumulate in humans through the consumption of meat and animal products. Furthermore, antibiotic-laden wastewater from institutions like animal farms and hospitals ends up in the ground water. ‘Van Dongen: ‘Good systems are needed to filter antibiotics and resistant bacteria from wastewater.’ To this end, AMR Insights, together with the company EWS, established the Dutch Consortium Antibiotics and Medicinal Residues from Water in 2020.

Spearheads in the fight against AMR

Both Martin and Van Dongen believe that prevention of infec- tious diseases is one of the most important ways to prevent many antibiotics from working at all in the near future. ‘They argue that, if people and animals do not become ill in the first place, antibiotics are not needed for their treatment, and further resistance does not develop.

To this end, they point to the importance of good hygiene standards and Antibiotic Stewardship, which is crucial in monitoring the use of antibiotics in humans and animals, and the reduction of unnecessary antibiotic use through better and quicker diagnostics and tests. Because the development of new antibiotics and modification of existing types of antibiotics, the experts see the search for new strategies as another vital strategy. These are viruses that selectively attack bacteria and render them harmless. To fully exploit the potential of these solutions, Van Dongen says that this information must be made available worldwide to effectively tackle the antibiotic resistance problem. The platform aims to provide this information in a targeted manner, as relevant aspects are different for a veterinarian than, for example, for a general practitioner.

Even though there is much to be done, Van Dongen remains optimis- tic about the future of AMR Insights: ‘Now, our income consists of project income, contributions for participat- ing in events and from sponsors. The objective is to change that model from short-term, sponsorship-based funding to long-term, programme-related funding. Then we will be able to set and realise our own group with sustainable funding. AMR Insights can go one step further to become a global information and knowledge platform with even more searchable information.’ Martin adds: ‘A lot of money is needed for further research and clinical studies.’ But while a current focus area is on the modification of antibiotics, it is certainly not the only way to tackle AMR, he concludes.
New sepsis marker speeds up detection and therapy

Sepsis is the cause of one in five deaths worldwide, killing nearly 11 million people each year, many of them children. It is also a major cause of disability, affecting millions more. To combat the condition, many hospitals have implemented sepsis performance improvement programmes. A meta-analysis of 50 observational studies showed that these programmes are associated with better compliance with sepsis resuscitation and management bundles as well as a reduction in mortality in patients with sepsis and septic shock.

Stay sharp, surgeons – your patients depend on it

Researchers at Auckland University of Technology’s BioDesign Lab and the University of Auckland’s Department of Surgery have uncovered a link between the sharpness of surgical implements and the risk of post-surgery infection.

The study, published in PLOS ONE, determines that keeping tools sharp is essential to avoiding cross-contamination. Bone surgeons are some of the most common surgeons, with approximately 9,000 hip replacements and more than 8,000 knee replacements happening in New Zealand every year, says Lecturer Lorenzo Garcia. Post-surgery infection not only reduces the patient’s quality of life; it also significantly increases healthcare costs. Reducing cross-contamination and possible infection will improve patient outcomes.

The osteotome is a surgical tool commonly used to chip, cut, and sculpt bone during various surgical procedures such as orthopaedic, plastic, and dental surgeries. This tool resembles a chisel, bevelled on both sides of the cutting edge and is like many bone-cutting surgical tools usually manufactured from either heat-treated Martensite, Austenite, or Martensitic Stainless Steel.

These materials allow surgical tools to withstand impact forces without fracturing. They also possess excellent properties of corrosion resistance, biocompatibility, and cost-effectiveness. Osteotomes are re-used in surgical procedures however lack of regular maintenance can lead to a dull or damaged cutting edge being used.

Three different osteotomes

The research performed at AUT showed that dull osteotomes, used in surgical procedures including common operations like knee or hip replacements, retain bone contaminants even after sterilisation.

The BioDesign Lab’s study tested three different commercially available osteotomes with different surface coatings. After four cutting and sterilisation cycles, contaminants including calcium and phosphorous (evidence of bone contaminants), chromium, magnesium, silicon, aluminium, carbon, and nickel (base material of stainless steel) and traces of chlorine (used in autoclave sterilisation water) were found.

Thanks to our commercial partner Sheffined we were able to test a range of different commercially available osteotomes with different coating treatments, to measure what affect the different coatings had on reducing cross-contamination. Our testing detected bone contaminants in each osteotome, says Dr Garcia. However, the PVD (physical vapor deposition) coated osteotome demonstrated significantly less bone contamination than the as-supplied or electroless nickel coated tool. According to the results, there is an association between blade sharpness and post-sterilisation bone contamination, so hospitals can maintain sharp tools, it follows the risk of cross-contamination will be reduced. Or alternatively, the use of disposable osteotomes could be recommended.

As-supplied osteotome cutting edge at x1000 magnification (left). Energy-dispersive x-ray spectroscopy (EDS) points for as-supplied osteotome (right). Mechanical wear and damage can be seen across cutting edge.

Source: Auckland University of Technology

Dr Jean Patel currently serves as the principal scientist, scientific affairs, at Beckman Coulter. Prior to her role at the company, Patel served as the science team lead, antibiotic resistance coordination and strategy unit, at the Centers for Disease Control (CDC), where she led implementation of its Antibiotic Resistance Laboratory Network and the CDC and FDA Antibiotic Resistance Isolate Bank. Patel has served as chair and vice chair of the Clinical and Laboratory Standards Institute Subcommittee for Antimicrobial Susceptibility Testing and worked with the World Health Organization (WHO) to develop technical guidance for detecting resistance and strengthening global surveillance of antimicrobial resistance.

As-supplied osteotome cutting edge at x1000 magnification (left). Energy-dispersive x-ray spectroscopy (EDS) points for as-supplied osteotome (right). Mechanical wear and damage can be seen across cutting edge.