



Report: Anja Behringer

Nosocomial infections cause more deaths than traffic accidents – a stunning discovery made in a recent German study. Worse: infectious diseases long thought eradicated in Europe, such as measles, tuberculosis (TB) and, more recently, syphilis, are also implicated. The increasing number of patients places an additional financial burden on healthcare. But – and this might be the good news – hospital hygiene finally receives top priority in German hospitals. Hygiene campaigns began ten years ago and today sanitiser dispensers are ubiquitous throughout any hospital. Alas, to little avail. No significant improvement can be reported despite the fact that a slew of new professions and specialisations have been created: physician hygiene specialist, nurse hygiene specialist, hygiene risk assessor, or infectiologist. We appear to be losing the battle against hospital acquired infections (HAIs). The problem is exacerbated by an ageing population, more susceptible to diseases, and by antibiotics losing their efficacy.

What can be done? Hygiene was the dominant topic, dissected from back to front during the European Health Congress, held in Munich. Results were not particularly encouraging – passing the buck appeared to be the chosen approach.

Hand hygiene – the be-all and end-all in the battle against microorganisms

'Wash your hands after going to the loo and before meals' – generations of children have learned this advice, and it's as valid today as 50 years ago; according to the World Health Organisation, 60% of all infectious diseases are transmitted by hand contact.

For Johanna Knüppel, expert and speaker of the German Nurses Association (Deutscher Berufsverband für Pflegeberufe – DBfK) in Berlin, the root cause of the long known and still unsolved problem is the glaring lack of staff, time and space. She does concede that the handwashing campaign did sharpen awareness, but, she asks, how do we disinfect? 'The quantifiable – and increased – use of sanitisers does not allow any conclusions as to the quality of the handwashing procedure. According to manufacturer information, the substance should be applied for 30 seconds. If nurses were to follow these instructions, they would spend 2.5 hours per day sanitising their hands.' No wonder, people try to cut sanitising corners – and increasingly, hospital managers understand the problem. Even the clinical bigwigs display 'organised neglect', as Professor Walter Popp, Vice President of the German Society of Hospital Hygiene (Deutsche Gesellschaft für Krankenhaushygiene) and Medical Director at Hykomed GmbH, in Dortmund, Germany, noted when he observed his colleagues in the operating room. It's not even hand sanitising that worries Popp but 'the way they handle patients with ears not covered'. A detail that goes unnoticed – and which is a symptom of the problem. The infection protec-

'The hygiene plan is nothing but a fig leaf'

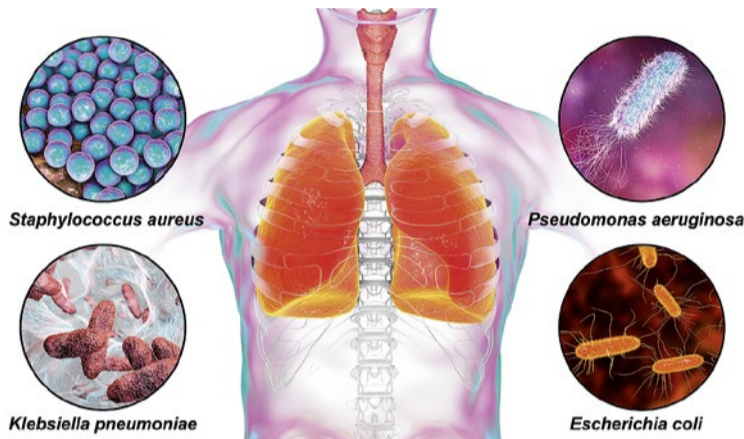
Where are the infectiologists?

tion guidelines issued by the German Commission for Hospital Hygiene and Infection Prevention (Kommission für Krankenhaushygiene und Infektionsprävention – KRINKO) are increasingly vague, as Popp underlines. Moreover, he adds, nobody knows from where all the needed hygiene specialists are supposed to come; and, even if they did exist, they alone could not level off the heap of problems.

In 2015, a 10-point plan to push back HAIs and antibiotic resistance, published by the then German Federal Ministry of Health, was met with enthusiasm. One of the few clearly phrased items in the plan: a special program designed to recruit additional hygiene staff by the end of 2016. When, after a transition period, the hygiene recommendations became binding, the target date was moved – to the end of 2019. Recruitment turned out to be sluggish. The Federal Ministry of Health put the blame squarely on the hospitals and regional governments. What the ministry failed to see: candidates are not rejected by the hospitals; candidates simply do not exist. After all, working conditions in hospitals are not particularly attractive.

Hygiene is rising to a top priority

Whilst physicians are the worst of role models, nurses are busy trying to implement instructions that are not grounded in any reality – a reality in which patients who have not yet been screened for microbes are parked in a hallway until rooms become available and where cleaning service contracts are put out to tender each year and the cheapest providers usually are awarded the contract without employees' competence being checked. The good news: physicians, at least in Germany, tend to be more reluctant to prescribe antibiotics. In Germany, 25 percent of all patients receive antibiotics, in southern European countries the rate is twice that number – 55 percent in Greece, for example, Popp points out. With increasing migration, infection control has become an international issue. While MRSA is retreating, the non-resistant variant of this bacterium causes thousands of deaths each year, according to a German Society for Infectiology report. In Germany, there are 400,000 to 600,000 treatment-associated infections each year, 10-15,000 of which are fatal. They are connected with hospital and non-hospital care as the Federal Ministry of Health has explained on its website since 2015. However, one third of these infections could be prevented with hygiene protocols, including measures such as appropriate equipment sterilisation.



Well-meant programmes from ABS to APS

'Since the "Microbial Threat" conference, held in Copenhagen in 1998, the 2001 EU report on "Prudent Use of Antimicrobial Agents in Human Medicine", so-called Antibiotic Stewardship Programmes (ABS)

are considered necessary to rein in antibiotic resistance by rational anti-infection protocols. ABS programmes have proved to influence resistance, costs and use positively, and have become an important component of patient safety in modern healthcare,' the ABS Initiative's website states.



Popp begs to differ. In his opinion, first there is no sufficient data pool on the administration of antibiotics in hospitals. Secondly, he claims, 'ABS doesn't work, since the freshly certified ABS experts, once they do exist in a hospital, don't have time for education and recommendations.'

Johanna Knüppel agrees. 'The main task of hygiene experts in nursing is handling the hygiene plan – which is nothing but a fig leaf anyway.'

The Aktionsbündnis Patientensicherheit e.V. (APS), an initiative founded in 2005 to focus on patient safety, is optimistic, since its first international day of patient safety was held with WHO support: 'APS

Continued on page 3

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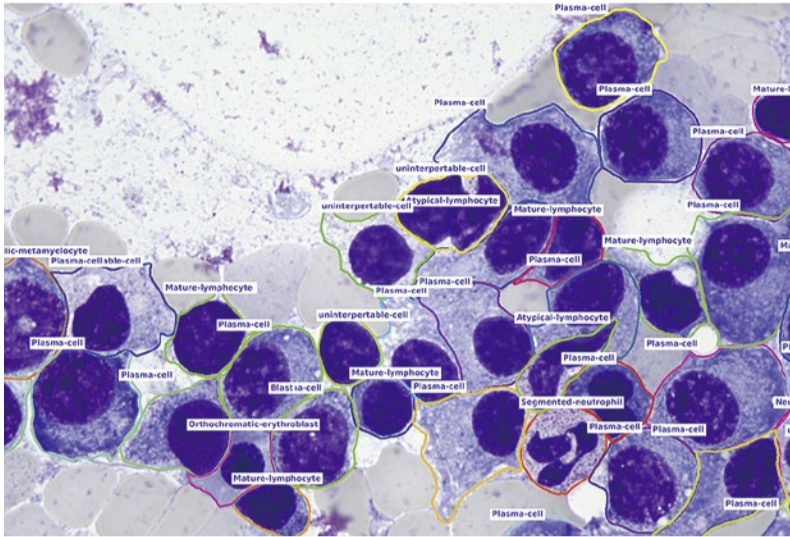
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A country encouraging intelligent medical innovations

Taiwan innovators shine at Medica



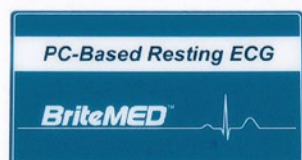
The aetherAI Bone Marrow Smear Differential Counting Model



Caduceus smart glasses allow surgeons to see through a patient's body



With innovative OLED solutions, WiseChip has won the Taiwan Excellence Awards for the third consecutive year



BriteMED's 12-lead Portable ECG can be used for bedridden patients in rural areas

Health tech Made in Taiwan is among the mainstays of every MEDICA; this year's fair is no exception. In co-operation with the Bureau of Foreign Trade (BOFT) of the Taiwanese Ministry of Economics and the Taiwan External Trade Development Council (TAITRA), 20 world-class healthcare companies are demonstrating innovative medical solutions based on national advances in Artificial Intelligence (AI), Augmented Reality and Virtual Reality (AR/VR), 5G and Robotics.

Growing economic importance

'This reflects the growing economic importance of medical technology for Taiwan as well as the manufacturers' ambition to expand their visibility in the European market with cutting-edge healthcare products,' TAITRA reports. 'Government support programs, known as the 5+2 Major Innovative Industries policy, enable companies located in Taiwan to invest substantial time and money in the research and development of new solutions from the "Asian Silicon Valley".'

Taitra is at Medica Taiwan Pavilion Hall 17 / A40

'Taiwan also embraces the opportunity to showcase its major advantages as a superior location for medical industrial development. TAITRA designates these advantages as "top medical technology", "comprehensive technology industry supply chain", and "sufficient energy of biotechnology manufacturing industry". 'Politics and business in Taiwan are closely connected to quickly and flexibly respond to current healthcare trends. Taiwan is already the most technically-advanced country among its peers when it comes to the development and use of state-of-the-art technologies. Now the dividends of these investments are clear: As the world of healthcare delivery makes the next leap to digitisation, Taiwan is at the forefront.'

Taiwanese manufacturers at Medica 2019:

aetherAI

'aetherAI is a shining example for the forward-thinking mentality of Taiwanese companies,' TAITRA observes. 'Partnering with the National Taiwan University hospital, it has built large datasets to leverage the possibilities of artificial intelligence for medical purposes. One of the promising outcomes is the world's first bone marrow smear differential counting model. Using artificial intelligence, aetherAI's modelling to evaluate tissue transforms diagnosis delivery from a laborious and time-consuming task into an actual mouse click.'

One aspect that makes cell counting such a demanding process is that bone marrow images need to be set to 1000x using oil immersion so the cells can be clearly identified. Even for a well-trained haematologist, or medical technician, this can take up to 30 minutes per case. By using the AI model deployed on aetherAI's Digital Pathology System, the counting result of one high-power field is available within 5 seconds. The model is trained with a dataset of over 300,000 annotated bone marrow cells, classified into 12 major

and 40 minor categories. 'We believe this achievement can benefit not just hospitals but, eventually, all leukaemia patients,' the manufacturer explains. 'Therefore, we are seeking partnerships, especially with local distributors, or medical device vendors, to help serve the needs of hospitals internationally. aetherAI aims to ease the burden of healthcare professionals and improve the quality of medical diagnostics by bringing top-quality AI into clinical practice.'

Taiwan Main Orthopaedic Biotechnology

For seasoned Medica visitors, Taiwan Main Orthopaedic Biotechnology is a well-known name: the company's VR solutions have gathered considerable attention in prior fairs, and reliably succeed in presenting new solutions and upgrading their established tech with state-of-the-art features, demonstrating increasingly refined products. 'The merit of this approach can be witnessed in the company's smart surgical glasses. Designed to augment the skills of surgeons during complicated procedures, it improves

outcomes through reduced procedure times and greater surgical accuracy. Traditionally, surgeons use fluoroscopy in concert with a display away from the incision to guide live anatomical orientation. With the smart glasses, surgeons can now focus on the procedure both physically and optically as the same graphic orientation is displayed directly onto the patient through mixed reality.

'The key products are mainly divided into two generations: Foresee-X and Caduceus. Foresee-X specialises in traumatic orthopaedics. Equipped with the glasses, an orthopaedic surgeon has an intuitive vision and can perform the operation without turning the focusing on screens during surgery. Foresee-X has obtained CE, FDA, TFDA certifications. Caduceus provides a powerful image-guided system for use in spinal surgery. It has been delivered to 510k and expected to obtain FDA certification in early 2020. Since the introduction of the product in 2017, it has won nine awards including CES award, R&D 100 and Edison Awards.'

'The 2019 version of the Caduceus smart surgical glasses features improved reduction of radiation exposure while using C-arm fluoroscopy for spinal surgeries. Without the need to focus on multiple separate screens, surgery time can be shortened by up to 70%.'

Taiwan Main Orthopaedic Biotechnology states: 'The smart glasses, with mixed reality, offer navigation with high precision,' confident that the firm's powerful surgical guidance system will be the standard in the near future.'

BriteMED

'Portable vital signs technology is the strong suit of BriteMED. The company's main product is a mobile 12-lead ECG machine, aimed to provide medical professionals with efficiency and bring quality medical care to patients,' TAITRA reports. 'Compared to the bulky traditional 12-lead ECGs, BriteMED's device features palm-sized design and a light weight of 157.5g, bringing benefits

in medical care service to rural areas. It also enhances nursing workflow efficiency, with easy integration on medical carts.'

'The intuitive software displays ECG waveforms in real-time and offers management of individual patient profiles and ECG reports. Its built-in defibrillator protection and pace-maker detection increases safety of operation in emergency situations. 'The report is saved as an electronic file, facilitating the integration to telemedicine systems and electronic medical records. Advanced features include simultaneous measurement of ECG, blood pressure, SpO2 and temperature, convenient for ward-round use and tele-diagnosis application.'

WiseChip

'Even with virtual and augmented reality around the corner, the need for advanced technology in conventional displays is not about to end any time soon. One of the innovators in this area, WiseChip is developing OLED displays with multiple advantages for medical applications. Due to the elimination of the need for passive matrix OLED (PMOLED) to be embedded with a touch sensor, screens are more flexible and can be developed and implemented into new devices more easily. These In-Cell touch systems feature enhanced brightness, ultra-thin design and wide viewing angles – both patient and practitioner benefit from these improvements.'

Faspro

Visual recording and transmission of procedures is increasingly important in modern healthcare. It is used to document procedures, allow interaction with off-site specialists and for experts to transfer their knowledge in educational settings. As an experienced developer of IT and camera systems, Taiwanese company Faspro Systems promotes this development with the release of MediCam, a sophisticated video recording and transmission headset. Its ergonomic design, visual capture quality and wireless capabilities combines the benefits of a reliable video recording and transmission device while not interfering with established workflows and procedures.'

Conclusion

'Double-digit export growth rates of 10.73 percent in 2018 underline the important role and prove the success of Made in Taiwan medical technology,' TAITRA points out. 'Taiwan has successfully completed its transformation from a manufacturing industry to a leading developer of digital solutions and applications to drive the positive development of medical treatments. Even though Taiwanese technologies are already being used globally in everyday life and are already playing a key role in European healthcare systems, the Taiwan Excellence stand in Hall 17 (A40) invites every visitor to explore tomorrow's technologies, get in contact with today's innovation leaders and learn about the direction of current developments.'

A press conference on Tuesday, November 19, at 10:00 am in Hall 8b, room 814A will present a detailed briefing and provide a collegial setting for thought-leaders to receive further information about these developments. Further information: <https://www.taiwanexcellence.org/de>

Amazon's AI powered personal voice assistant

'Alexa' joins the NHS

It's a world's first. The UK's National Health Service (NHS) is collaborating with Amazon to provide reliable health information from the service's website through voice-assisted technology.

Report: Cornelia Wels-Maug

Before the collaboration, consumers could seek health assistance from Alexa – Amazon's AI-powered personal voice assistant – but it's only since July that Alexa can solely source NHS-verified health information. In a speech announcing the service, Matt Hancock, Secretary of State for Health and Social Care, 'addressed the need for dependable information: 'So, when sick people need medical information, they'll receive NHS information: accurate, reliable, safe. This will particularly benefit people who rely on voice-activated tech because they struggle with other devices.' Knowing all too well the worrying outcome a random Google search on health issues can produce, Hancock continued: 'We all know that Dr Internet can potentially misdiagnose a minor ailment as something terminal, but what about the converse?'

Now Alexa will be able to answer questions such as: 'Alexa, how do I treat a migraine?' 'Alexa, what are the symptoms of flu?' 'Alexa, what does chickenpox look like? Alexa will also provide guidance, explained Hancock. 'It means people will know when they should see their GP or go to A&E. And when, and how, they can treat common illnesses with the help of a pharmacist', he emphasised.

Facilitating access via voice commands

This agreement particularly addresses the needs of elderly or blind patients and those who cannot access the internet via traditional devices. It also reflects the growing relevance of voice-enabled searches. The DHSC quoted an estimate that by 2020, half of all searches will be made using voice-assisted technology. The NHS does not plan to give patients Amazon Echo devices – the voice-activated speakers that connect to the Alexa service, but to facilitate access via a free app.

By taking some of the burden off general practitioners (GPs) and other NHS services and using technology to give advice on common ailments instead, the collaboration is an attempt to lessen the strain on the



Black tablet computer beside round white portable speaker

healthcare system.

This is not the first time the NHS uses Amazon's voice technology. Partnering with AWS and Arcus Global, the NHS Business Services Authority (NHSBSA) has already used Amazon Lex – the conversation engine that is also behind Alexa – to automate processes in its contact centres. This is also not the first time that the NHS has teamed up with private sector companies to deliver healthcare: Babylon Health, Push Doctor and Now GP, among others, offer remote video appointments with GPs.

Digitising healthcare delivery

This initiative is part of a much broader strategy laid out in the NHS Long Term Plan published in January 2019. To improve the quality of patient care and health outcomes whilst lessening pressure on the health service over the next ten years, it intends to make more services available digitally. These will be implemented by the newly created NHSX, the digital

arm of the NHS, launched earlier in July 2019. One of its first tasks will be to spearhead the Alexa service as part of its broader remit to foster the digital transformation.

'By working closely with Amazon and other tech companies, big and small,' commented Matthew Gould, NHSX's chief executive, 'we can ensure that the millions of users looking for health information every day can get simple, validated advice at the touch of a button or voice command.'

'Part of our mission at NHSX is to give citizens the tools to access services and information directly, and partnerships such as this are an important part of achieving this.'

Healthcare is not new for Amazon

The Amazon/NHS collaboration is just one example of Amazon's recent attempts to strengthen its presence in the healthcare space: In 2018, the company joined forces with Omron Healthcare to allow a blood pressure monitor to be controlled

through Alexa; it agreed to purchase US-based online pharmacy PillPack and was granted a US patent allowing Alexa to recognise if a person is ill by analysing speech and suggest a shipment of appropriate medication. Additionally, Amazon announced software that mines patient health records for information that helps physicians improve treatments and hospitals cut costs. The company highlighted the insights can help healthcare organisations with clinical decision support, revenue cycle management and population health.

Who else listens, Alexa?

The announcement of Alexa's official admittance into healthcare has prompted privacy concerns as Amazon's employees listen regularly to recordings from the Echo devices as part of the development process for new services. However, Amazon stressed it would not share any health

data with third parties, nor make product recommendations, or build a profile of customers' health based on the collected audio information. An Amazon spokesperson reassured that all data was encrypted and kept confidential, adding: 'Customers are in control of their voice history and can review or delete recordings.'

Hancock's vision for the future

Technology will play a significant part in how Hancock envisions the shape of tomorrow's healthcare. And, for this, he is determined to introduce 'tech that people use and rely on every day'. Therefore, the collaboration with Amazon will be the first in a series of others with businesses that can deliver to this tune: 'And I want to see us build similar relationships with Google, Apple and anyone else ...'

Perfect illumination aids diagnosis

Find the right light



ACEMST1, a new flexible medical LED light from the Italian manufacturer ACEM, has an illumination suitable for diagnoses in dermatology, general medicine, gynaecology, and dentistry – and can even be used as a bedhead light.

The manufacturer also reports that this compact lamp ensures excellent light intensity, an IR-free beam, variable colour temperature (CCT), a high colour rendering index (CRI), low power consumption, and long life. The lamp comes in different colours and is also reported to be easy-to-clean and disinfect, as well as easy to move, with wide rotation and movement range. Also, once positioned, the double balancing system assures

stability and accuracy, the firm adds.

A wall extension arm, ceiling, wall, table, rail, or trolley mountings are also available.

The two models: ACEMST1.1 and ACEMST1.3 model both provide touch control panels, but the latter also benefits from on/off Gesture Control. Both have light intensity adjustment, but the 1.3 also provides stepless colour temperature adjustment (from 3,500 K to 5,500 K).



ACEM is at Medica Hall 10 / Stand B60



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Continued from page 1

will continue to point out the issues that obstruct safe patient care.'

To make a long story short: Improvements, or even solutions to the hygiene problem, are not in sight even though everyone is busy working on them.

And politics? In the political arena, cynics would say, the motto 'only a dead patient is a good patient' appears to prevail. The ones still alive need to try to be well informed and prepare themselves for their hospital stay, for example when surgery is scheduled. The best way to begin: Ask your family doctor to screen you for multi-resistant bacteria, try to eradicate them and make your immune system fit for the hospital environment. If you do this, you enter the OR as a 'healthy' person, and your chance of leaving the OR and hospital in the same healthy state increases considerably.

A local government committed to growth

N. Ireland's scientific presence

'Northern Ireland (NI) is a prime location for Life & Health Sciences businesses, thanks to a unique combination of talented people, world-class research and strong links between industry, academia and clinicians, in the commercialisation of innovative research,' as explained by the organisers of the Northern Ireland exhibits in Hall 16 Stand K11-1.

'The region has a strong reputation within the sector, with expertise across a range of specialties that include precision medicine, diagnostics, connected health, clinical trials and data analytics. It has a vibrant cluster of 170+ businesses, which are a mix of international investors and indigenous companies, which continue to grow and prosper in the region – a testament to Northern Ireland's compelling proposition.'



The Northern Ireland Life and Health Sciences sector Hall 16 / Stand K11-1

'The area offers a highly skilled, experienced and adaptable workforce; a cost competitive location and a pro-business environment, with local government committed to growing the sector, with financial incentives including grants for product development, employment, training and R&D, available to companies investing in the region.'

'Northern Ireland's Life & Health Science sector also boasts an established reputation for innovation in the health technology sector and a strong scientific research base. NI's two main universities, Queens University Belfast (QUB) and Ulster University (UU), rank among the top 10 in the UK for bioscience research, with more than 1,000 researchers in the region's Centres of Excellence. Today, NI researchers are at the forefront of convergent technology in

health data analytics, machine learning and diagnostics.'

The organisers of the Northern Ireland exhibits stand report on the ten Life and Health Sciences companies which are sharing their knowledge, capability and new products at Medica 2019:

Armstrong Medical www.armstrongmedical.net

Armstrong Medical, based in Coleraine, Northern Ireland, is a specialist manufacturer of respiratory consumables for critical, perioperative and neonatal care. The company seeks to understand customers' needs to help streamline the delivery of care, saving user's time and reducing waste.

Biopanda Diagnostics www.biopanda-diagnostics.com

Biopanda Diagnostics is a dynamic UK-based company specialising in the manufacture and marketing of high quality cost-effective support reagents for research institutes and the in vitro diagnostic industry worldwide. The company exports to research laboratories, universities, hospitals and test kit manufacturers across the world.

Biopanda Reagents Ltd www.biopanda.co.uk

Biopanda Reagents develops and manufactures in vitro test kits for clinical laboratories, veterinary practices, and food safety, both locally and globally. The company is reported to provide innovative, high quality and cost-effective test reagents that offer the sensitivity, specificity and



accuracy that customers demand. Biopanda has been certified an ISO 13485:2016 compliant organisation.

Ciga Healthcare Ltd www.cigahealthcare.com

CIGA Healthcare specialises in the Rapid Self-Test Health Diagnostics sector and is leading developments in the rapidly emerging OTC market. Established in 2005, the company has grown rapidly and now supplies tests to retailers in the UK, such as Sainsburys and Boots, the USA and to 60 countries worldwide.

Elite Electronic Systems Ltd www.elitees.com

Established for over 25 years, Elite have leading capabilities in electronics medical device manufacture and are accredited to ISO9001 and ISO13485. Elite specialises in Printed Circuit Board Assembly (PCBA), cable assembly and complete system build – all tested to bespoke customer requirements.

Glenbio Ltd www.glenbio.com

Glenbio manufactures a wide spectrum of world class diagnostic reagents (clinical chemistry, immunology and haematology) from its purpose built facility in Northern Ireland. Glenbio currently sells to over 50 countries worldwide and invests heavily in R&D to develop new assays and continuously improve existing tests.

Intelesens www.intelesens.com

Intelesens are an innovative MedTech company manufacturing and supplying Defib Electrode Arrays to multiple global customers. The company's Zensor product is still the world's only 14 day hybrid 3-lead ECG, respiration and activity monitor enabling remote and full disclosure detection of common cardiac arrhythmias.

Linnodee Diagnostics www.linnodee.com

Linnodee Limited, established in 1999, develop new, innovative and rapid diagnostic tests for existing and emerging infectious diseases in animals (bovine and porcine) and humans, with particular expertise in Leptospirosis diagnosis. The Leptorapide kit is a rapid latex agglutination test to detect Leptospirosis using human serum.

Neurovalens www.modiushealth.com

Neurovalens is a global health-tech company that creates non-invasive neurostimulation products used to solve some of the world's greatest health challenges. The company's first product, Modius Slim, uses neuro-technology to make weight loss easier by reducing appetite and cravings. Neurovalens' mission is to improve global health and wellness using drug-free neurological solutions.

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An internationally coordinated strategy may help

HAIs are one problem – MDROs another

In view of the increase of multidrug-resistant organisms (MDRO), the World Health Organisation (WHO) has declared antibiotic resistance one of the biggest threats to global health. MDROs have become a major problem particularly in hospitals. Professor Dr Georg Häcker, President of the German Society of Hygiene and Microbiology (DGHM) and Director of the Institute for Microbiology and Hygiene at the University Hospital Freiburg, explains some strategies to prevent hospital-acquired infections (HAIs), also known as nosocomial infections, and to contain the further development of multidrug-resistant organisms.

Interview: Sascha Keutel

Dr Georg Häcker: 'Hospital-acquired infections are all infections acquired in or present in a hospital. They can be self-infections when the infecting organism is derived from the patient's own skin, gastrointestinal or upper respiratory flora. A severely ill patient,

for example, treated in hospital over a long period of time, might inhale bacteria from his or her own oral microflora into the lungs and develop pneumonia. This is also considered a nosocomial infection – and is one that can hardly be prevented.

'HAIs, however, also can be transmitted from patient to patient, or

from staff to patient, or they can be so-called environmental infections. Infections caused by sharing a toilet, or infections from staff to patient, to a large extent can be avoided. Complete prevention of all HAIs, however, is pretty much impossible since people and bacteria live at close quarters, so to speak.

'The many routes of transmission pose many challenges and require a wide variety of measures. In some cases it might make sense to remove certain bacteria from the patient, in order to prevent self-infection. Staff, visitors and fellow patients must be instructed to follow simple hygiene practices, such as hand hygiene. The patient environment, such as tables, or the toilet as well as instruments and equipment with patient contact must be disinfected or sterilised according to a scientifically validated plan.

'The patient microflora is most likely the biggest challenge because it can only be partially controlled and, obviously, cannot be removed. Implementation of effective hygiene measures in hospital routine, particularly in view of the often less-than-ideal working conditions, presents another problem.

'It's important to note that most HAIs are not caused by multidrug-resistant organisms. HAI and multidrug resistance are two distinct problems and the overlap of these problems – that is nosocomial infections caused by MDRO – is rather small.'

Are antibiotics still the only choice to fight infections?

'The short answer is an unconditional "yes"! While some bacteria have developed resistance against all active substances, this does not mean that all bacteria are, or will become,

resistant to all antibiotics. Case in point: penicillin. Staphylococcus aureus and Streptococcus pyogenes used to be susceptible to penicillin; they had to develop resistance. Due to the medical use of penicillin, and related antibiotics, Staphylococcus has become resistant. Today, approximately 90 percent of Staphylococcus aureus in patient samples are penicillin-resistant. Streptococcus pyogenes, on the other hand, is still penicillin-susceptible.

'There are many different kinds of bacteria and they develop in very different ways with regard to resistance. As far as bacterial infections are concerned, antibiotics remain the first-line therapy and most bacterial infections can be successfully treated with antibiotics.

'Having said that – there were indeed cases of bacterial infections where no antibiotic was effective due to resistance. In Germany, these cases are very rare, but in some regions of the globe the situation is serious. Therefore, it's imperative that we try to contain the spreading of multidrug-resistant organisms as much as possible. Most prognoses, for Germany and the entire world, see an increase in the number of infections that are difficult to treat or entirely untreatable.'

Is work to create new antibiotics and active substances progressing?

'There are indeed some enhanced active substances and combinations of active substances that effectively combat certain highly resistant bacteria. Additionally, there are new active substances, or classes of active substances, against certain bacteria. For some bacteria no substance has been developed. In general, this is a wide and complex issue. While it's true that the development of antibiotics does not enjoy top priority among the large pharmaceutical companies, there is some research activity. It's clear, though, that the one antibiotic that will effectively combat all bacteria is not in the wings. Bacteria will most certainly become resistant

to the new antibiotics classes. Thus, it's of paramount importance to use antibiotics correctly and strengthen all elements of infection medicine.'

Are there no advances regarding total antibiotics resistance?

'There is no single approach to solve the problem forever, but there are different approaches that help us to better understand the problem and evaluate the scope of the problem. Moreover, there are new ideas on how to strengthen healthcare structures to minimise the development and contain the spreading of antibiotic resistance. For some time, researchers have tried to use bacteriophages that infect and destroy bacteria that are resistant to antibiotics. This approach is promising but at this point it is too early to make any predictions regarding the possible success of such a treatment.'

What other strategies aim to stem the tide of MDROs?

'The term "multidrug-resistant bacteria" encompasses heterogeneous organisms and is also used inconsistently. One of these bacteria is MRSA, which causes different problems in different countries. In Germany, the number of MRSA infections has been decreasing for a few years. The most troublesome are the so-called gram-negative bacteria, another heterogeneous group, since antibiotics are basically ineffective with all infections they cause. In some countries these bacteria are ubiquitous; in Germany they are either imported or home-grown due to antibiotics use.

'Specific strategies tailored to different bacteria must be developed. Our most important "broad spectrum" strategy is strengthening and coordinating the three pillars of infection medicine: infections must be detected quickly and antibiotic susceptibility must be determined quickly and reliably. This is the task of microbiology. Bacterial infections have to be treated quickly and correctly. This requires adequately trained physicians. Transmission of resistant bacteria between people,

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Electronic monitoring of hand hygiene

Smarter surer cleanliness

'Electronic monitoring systems are proven to assist healthcare institutions to make sustained improvements in hand hygiene compliance.' [Scheithauer S, et al. Do WiFi-based hand hygiene dispenser systems increase hand hygiene Compliance? American Journal of Infection Control (2018)]. 'Using these systems,' adds the manufacturer Ophardt Hygiene, 'a continuous stream of objective data is available at the click of a button, allowing hygiene personnel to provide prompt feedback on hand hygiene behaviour.'

'Intelligent hygiene dispensers record the location, a time stamp and the dosage dispensed for each disinfection event. This data is then sent

to a web-based software enabling hygiene personnel to deliver training where compliance falls below targets, and optimise dispenser locations to further encourage hand disinfection.'

Digital hand hygiene of the next generation

The ingo-man plus dispenser series is the number one dispenser in German hospitals, the company points out. 'Millions of these dispensers are installed on the walls of hospitals and clinics around the world. In an effort to enable existing dispensers to support the transition to digital hand hygiene, Ophardt Hygiene has unveiled a new innovation with the

ingo-man SmartNose. The SmartNose is an intelligent, retrofittable unit that allows the smart conversion of all existing manual 500 ml ingo-man plus dispensers.'

Installation takes less than 30 seconds by replacing an existing dispenser's face shield (nose); no other changes are needed. A feedback LED is integrated with the SmartNose, which immediately lights up once sufficient disinfectant has been dispensed, the company explains, adding that this ensures the right amount of product has been applied for a thorough hand disinfection.

Many licensed Ophardt Hygiene Monitoring Systems have been tailored to suit specific needs and are now installed in European hospitals.

*The intelligent 'nose' is also available as a pre-assembled solution in the Ophardt's dispensers – on show at this year's Medica.



**Ophardt Hygiene is at Medica
Hall 6 / Stand K20**



Professor Georg Häcker MD gained his doctorate in medicine in 1991, at the University of Ulm, Germany. Today, he presides over the German Society of Hygiene and Microbiology (DGHM) and is Director of the Institute for Microbiology and Hygiene at Freiburg University Hospital. In his research, he focuses on the molecular mechanisms of cell death, cell death in the immune systems and the infection biology of Chlamydia trachomatis.

particularly in hospitals, must be avoided as much as possible – the task of hospital hygiene teams. The combination of these three strategies can reduce evolutionary pressure on bacteria and spreading of multidrug-resistant bacteria can be significantly contained.'

Should those strategies be applied on national/international levels?

'Each country has its own native healthcare system, which is very difficult to influence by international efforts. Also, the resistance situation differs from country to country. Thus, national strategies that consider local structures are pivotal. At the same time, knowledge transfer is important, since not all countries have adequate mechanisms in place to map and understand multidrug-resistant organisms. We all have to try to use the knowledge that exists on the global level.

'An internationally coordinated strategy would be helpful. Indeed, the key points have already been spelled out by the WHO. But strategies that are successful globally not only need the political will but significant structural improvements and financial investments in the individual healthcare systems. Last, but not least, we need changes in lifestyles and our perception of the issue. We have to work on these strategies without falling prey to the illusion that they can be implemented quickly and that they will quickly yield major results on the global level.'

A wearable to determine biomarkers

ELSAH, the smart patch

The EU four-year project ELSAH, which began at the dawn of 2019, aims to design a wearable to enable continuous determination of biomarker concentrations. Sascha Keutel interviewed project coordinator Dr Joerg Schotter, Molecular Diagnostics, Centre for Health & Bioresources, AIT Austrian Institute of Technology GmbH, who explains the project's objectives and potential applications for the planned wearable.



ELSAH PROJECT

ELECTRONIC SMART PATCH SYSTEM FOR WIRELESS MONITORING OF MOLECULAR BIOMARKERS FOR HEALTHCARE AND WELL-BEING

'The market for wearables – devices that monitor the fitness status of the user in real time – is growing rapidly,' Dr Joerg Schotter explained. But, he added: 'These are mainly devices that measure the physiological parameters, such as heartbeat or oxygen saturation in the blood. These wearables cannot determine the molecular biomarkers in biological fluids that are important to obtain a better insight in certain illnesses or health conditions. One problem here is that such analysis requires direct contact with the user's biofluids, normally blood. However, blood extraction is an invasive technique that is incompatible with the needs of wearable users.'

'To overcome this obstacle, we want to develop an integrated sensor system that can be worn on the body. ELSAH stands for "Electronic smart patch system for wireless monitoring of molecular biomarkers for healthcare and well-being". Our smart patch ought to determine the concentration of molecular biomarkers in the skin, more precisely the interstitial fluid, in a minimally-invasive fashion.'

itoring of molecular biomarkers for healthcare and well-being". Our smart patch ought to determine the concentration of molecular biomarkers in the skin, more precisely the interstitial fluid, in a minimally-invasive fashion.'

For which fields is the patch intended?

'In the first demonstrations of our patch, we chose glucose and lactose, among the most established biomarkers, to measure a healthy way of life. Lactose has a similar objective to that of athletic watches to

determine the user's training condition. Applying the lactose parameter, hyperacidity of the blood can be controlled and thus the optimum training range determined. By measuring glucose, on the other hand, we can monitor the nutritional condition of the user. This wearable is supposed to support the user in daily decisions for a healthy way of life, for example if this person wants to maintain a certain diet, together with a workout program.

'The smart patch opens completely new opportunities for use of wearables for evidence-based applications in the health and lifestyle field. Their use can lead to improved health and increased well-being. In the longterm, we expect they will also lead indirectly to a reduction in the number of popular illnesses, such as obesity, cardio-vascular illnesses, high blood pressure or type 2 diabetes.'

'At the end of the project period we want to present a demonstrator that we have developed together with our partner, the German Sport University Cologne. This demonstrator is then to be evaluated in a limited user group both in the laboratory and at home monitoring.'

How does this technology work?

'Currently, a series of wearables have been developed that use non-invasive biofluids, such as sweat, saliva or natural eye fluid. These systems often have to deal with specific challenges, such as poorly defined corre-



Dr Joerg Schotter joined the Centre for Health & Bioresources at the AIT Austrian Institute of Technology GmbH in 2005, where today he researches new ways and principles to identify and analyse biomolecules. Within this context, he also coordinates the ELSAH project.

lations of biomarker concentrations. 'Our portable sensor system ought to overcome this problem. The patch comprises micro-needle biosensors, a microchip, printed antennae and a printed battery. The micro-needles can be placed and worn painlessly. A "patch applicator", a kind of spring, ensures that the patch lies properly on the skin and that the micro-needles are properly placed. The electronics in the patch function autonomously and measures independently; the data is transmitted wirelessly to the appropriate user app.'

'The patch makes wireless transmission of collected data to the user's app possible and thus permits real-time measurement of both biomarkers. At present, we plan the measurement per patch for 24 hours.'

Are many others involved in the development?

'The project consortium comprises ten partners from five European

Continued on page 9



The electronic monitoring solution can fit into existing dispensers

Xpand the frontier of the possible

MKC-X800: NATIVE 4K MEDICAL GRADE CAMERA

MKC-X800 is the beginning of Ikegami's new camera generation for 4K resolution. MKC-X800 is a 4K-native progressive-scan 1-CMOS model with an ultra-compact head designed to be operated from a remote CCU. Features include ultra-high resolution, intuitive GUI and single cable 4K output.



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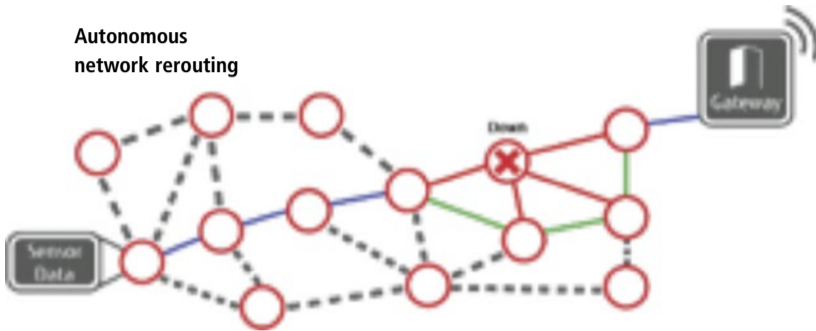
Visible Beyond

Please visit us in Hall 10/B12

The benefits of making hospitals smart

The IoT mesh network

Refining hospital processes saves costs, improves workflows and patient care plus outcomes. To realise those aims, a hospital in the Netherlands has installed an Internet of Things (IoT) mesh network.



A pilot project initiated by a Dutch children's hospital has enlisted an entire ward as an Internet of Things (IoT) playground, to experiment with various type of tags, sensors and switches in a 'mesh network'. This specific solution offers significant advantages over conventional mesh network technologies; it provides the ability to construct highly scalable, high-density networks of connected devices without any interference to medical equipment.

Asset tracking

The hospital's initial focus was tracking equipment: beds, incubators, infusion pumps are among many items that 'go missing', despite good organisation. Locating lost gear

drains medical staff time. IoT tags, sometimes referred to as track/trace modules, can attach to anything. Location data can also be used for stock control, for example alerting Facility Management when stocks are either too low or too high and re-location is required. Sensors can signal the need for washroom towel replacement, or alert about liquid spilled on a floor, etc.

Unlimited assets can be added to, or removed from, a mesh network, without maintenance. Asset tags simply reroute the information. Historical data can also be used to optimise the flow of assets. Heatmap apps enable visualisation and alerts to congested areas, e.g. hallways.



Hospital ward features track/trace tags on beds and intelligent lighting

Smart lighting and switches

Light is important for patient well-being and staff productivity, as well as energy conservation. The IoT solution encompasses a connected, intelligent lighting system, which combines low-latency operation for light control with the high data rate network, to capture data from various sensors. Sensors capture key data about their surroundings, such as occupancy, motion and air quality. They can last for years within this network thanks to the ultra-low power mode of connected devices.

At the Dutch hospital, smart LED lighting fixtures act as anchor nodes in the mesh network, through which the battery-powered mobile tags communicate their positions. This solution proved no more expensive than a normal LED lighting upgrade. Being mains-powered, the lighting



provides a very low latency network that makes it simple to extend the scope of IoT applications running on it.

By integrating energy-harvesting wireless switches, the energy

The mobile app shows location of hospital assets

produced by pressing the button is enough to switch the light, or call for assistance, a bed, or any other need. A bonus: the lighting also offers daylight compensation, smart grouping and lighting plans based on presence or personal preferences. Presence sensors provide occupancy data, enabling further efficiency savings.

Environment monitoring

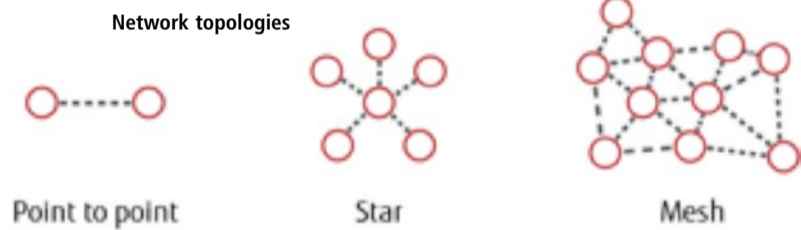
The aim is to create ideal conditions and an environment in which staff can work and patients feel good. Implementation of the solution is a very small step to add an additional layer for environment monitoring. Full insight in environmental conditions, and thus control, has been gained by equipping nodes with temperature sensors and putting CO₂ sensors in place – even the hospital fridges are equipped.

Wayfinding

Hospital mapping is another significant challenge. Navigation and wayfinding are currently photo-based. However, by including beacons in the IoT, mesh nodes can transmit standard Bluetooth beacon messages to indoor mapping and navigation apps. The mobile application gives users accurate positioning in real-time on their mobile phone, along with wayfinding and turn-by-turn navigation.

The Dutch hospital has just embarked on a winning journey.

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Care: Middle ear infections

Pocket-size ultrasound device improves diagnosis

In children, middle ear infections are the number one indication for antibiotic prescriptions or surgery. Nearly every child around the world will suffer at least one middle ear infection

(otitis media) severe enough to see a doctor, and most will experience repeat occurrences throughout childhood. Internationally, there is significant over-prescription of antibiotics

for otitis media, leading to unpleasant side effects, additional doctor visits, personal antibiotic resistance, and a rise in antimicrobial-resistant bacteria. Yet, undertreatment can lead to surgery or permanent hearing loss. These episodes are painful, costly, time-consuming, and difficult for children, parents, and caregivers.

Current diagnostic tools are decades old and cannot characterise the type of infection present. The otoscope, primarily used for diagnosis, has essentially not changed since the early 1900s. Using an otoscope, the physician visually examines the outside of the tympanic membrane (eardrum). To assess whether a middle

ear infection is viral or bacterial, clinicians need additional information to properly characterise the infections and accurately determine whether an antibiotic is appropriate.

OtoNexus Medical Technologies' state-of-the-art advanced ultrasound otoscope analyses the presence and type of effusion behind the eardrum, so that primary care paediatricians can instantly and accurately assess middle ear infections. This type of information has never been available before without an invasive procedure.

The OtoNexus device resembles a traditional otoscope and can fit in a lab coat pocket, but that is where the similarities end. The advanced otoscope leverages the capabilities

of a unique and patented ultrasound technology to assess the presence and type of effusion behind the eardrum in children and adults. Unlike other ultrasound technology, this device does not utilise ultrasound gel, but instead works through the air, making it ideal for use in the ear. In addition, it can take photos and videos.

The inexpensive ultrasound device provides data in seconds and is easy to use by physicians or non-physician personnel worldwide. A tool that provides a quantitative, definitive approach to the diagnosis of viral versus bacterial middle ear infections is essential for treatment, the manufacturer adds. 'At last, clinicians will have a tool to determine the smart use of antibiotics. Definitive, objective diagnostic data identifying both the presence and type of effusion behind the eardrum will lead to improved patient outcomes, better and faster treatment, reduced antibiotic usage – and significantly reduced healthcare costs.'



**OtoNexus is at Medica
USA Pavillion Hall 16 / Stand F11-1**

Raising the bar in surgical microscopy

A new ultra-compact microscopy camera

The MKC-X800 ultra-compact camera is a new addition to Ikegami's range of medical imaging equipment, which, the firm reports, sets higher than ever standards of imaging quality to capture the precise colour and image detail of surgical operations. Measuring just 28x28x52mm WHD and weighing 100g, it can be mounted on a surgical microscope, lightweight support stand or boom.

With its 4K-native sensor and advanced signal processing, the MKC-X800 delivers outstandingly precise detail (1800 TV lines horizontal resolution) and low picture noise. Connection to its control unit is by a

single coaxial cable, which can be up to 15 metres in length. All functions can be accessed via an easy-to-use touch-screen user interface panel. Camera head and control unit have antibacterial-coated surfaces.

Stereoscopic configurations for head-up surgery can be deployed quickly by assigning two cameras as master and slave. The slave camera automatically follows any change in master camera control setting.

HDR mode delivers wide dynamic range video reproduction. This func-

tion ensures that high quality display extends both to dark and bright parts of the image. The system's wide colour gamut (BT.2020) ensures accurate reproduction of fine details, such as small veins.

Electronic zoom function allows Full-HD images to be selected from the 4K-UHD source without degradation. This mode can be pre-set or adjusted in real-time by the CCU operator.

Camera sensitivity can be doubled while maintaining the 1800-line UHD



video resolution. Total sensitivity can be further enhanced up to four times normal to inspect very dark image areas.

Colour correction can be applied more easily than ever via a newly designed rotary switch or by tuning 16 axes of the colour gamut.

Additional functions accessible at the CCU include automatic or manual gain, white balance, shutter speed, knee, pixel mix, line mix, pixel/line mix, detail enhancement, vertical and horizontal image inversion and up to four times digital zoom. Four groups of scene file settings can be stored as

control function pre-sets. All scene files are name editable.

The MKC-X800 can output in a variety of signal formats, such as quad-link 3G-SDI, HDMI 2.0 or 12G-SDI. Originated for the professional broadcast sector, the 12G-SDI signal format allows easy 4K-UHD connection over up to 50m of single coax cable. 4K-UHD and 1080p/1080i HD can be output simultaneously. Full-HD can be captured directly to the Ikegami MDR 600HD video recorder. The MKC-X800 can be connected to Ikegami's MLW-2750UHD 4K monitor via a single HDMI cable.

**Ikegami is at Medica
Hall 10 / Stand B12**

Continued from page 7

countries. Preparation for the measurement of biomarkers in the skin, using micro-needle biosensors, comes from Tony Cass, Professor of Chemical Biology in the Department of Chemistry and Institute of Biomedical Engineering at Imperial College London. Cass has already shown that glucose in the interstitial fluids of the skin is measurable with microneedles and that there is a correlation to the amounts measured in blood. Along with Imperial College London, the German Sport University Cologne and AIT, the research institutes Centro Tecnológico LEITAT (printing of antennae) and Tyndall National Institute (production of micro-needles) are involved.

'Our partners in the industry are DirectSens GmbH (development of enzymes for the biosensors), LykonDX GmbH (app development and use), Saralon GmbH (print of batteries) as well as Infineon Technologies Austria AG (manufacture of microchips). Sanmina Ireland Unlimited Company is the partner that takes to the overall integration of the patch. Sanmina will also produce the applicator that enables controlled application of the patch to the skin.'

Further details:

<http://www.elsah.researchproject.at/>

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are encouraged to move joints and muscles regularly and intensively to hasten healing. Without mobilisation, complications such as restricted mobility can arise later. The easy-to-use rehabilitation robot Robert aims to prevent this.

At the local University Hospital, staff worked manually to rehabilitate patients, Rune Kristensen, CTO of Life Science Robotics, pointed out. 'It was physically demanding and took a lot of time. The idea was to automate the process.'

Unfortunately, the prototype incorporated an industrial robotic arm. 'We quickly realised it would be really difficult to obtain the necessary certifications for a medical product,' Kristensen recalled. A medically compliant robot was the key to quicker and easier development.

KUKA and the LBR Med

'We heard that KUKA had just developed the LBR Med, a lightweight robot intended specifically for medical applications,' Keld Thorsen, LSR's CEO, said. Meeting at KUKA's HQ in Augsburg, it became clear that Robert and the LBR Med (already certified for medical use) belonged together. Implementation of the solution was tackled in a close cooperation. 'KUKA provided us with



the services of a development engineer who gave us detailed insights into how the robot works,' Thorsen explained. Life Science Robotics hired a software developer specifically to create the human-machine interface. 'KUKA supported us again during the familiarisation phase, enabling really fast progress,' the CEO added. The greatest challenge was that Robert had to be very easy to handle, despite its high complexity. 'After all, it's operated by nurses or therapists, not by technical personnel,' Kristensen underlined.

Keld Thorsen, CEO of Life Science Robotics

Clinical tests

Since early 2017, the entire LSR team has invested time and expertise in Robert to develop a competitive robot solution and one, above all, suitable for everyday use, the company collaborates closely with Aalborg University Hospital – Robert's initial birthplace – and other hospitals. The LBR Med, the only robot certified for integration in medical products, is facilitating the certification process. 'Clinical tests have been running independently in eight different hospitals and nursing homes since September 2018. We have already received valuable feedback,' Kristensen confirmed.

'This enables us to offer not only a technologically smart solution but also one that provides effective relief for nurses and therapists in their everyday work.'

The tests also confirm very specific advantages. Robert works highly individually, flexibly, and with great accuracy. It can perform exactly the same movements over and over again – without interruption, fatigue or time restrictions.

Therefore, Robert is delivering economical feasible rehabilitation. Nurses can be enabled to perform other duties, although still monitoring the patient, who can also be mobilised more frequently.

Efficient and simple

Pointing to aging populations, decreasing nurse numbers and a weightier public (around 15% of EU citizens are obese), Thorsen believes Robert fills an important gap. Thus, initially, Robert focuses on lower limb mobilisation – the heaviest body part and thus the hardest to mobilise, Kristensen explained. Blood clots and stiff joints are common there. To walk sooner, leg muscles and joints need training quickly after surgery.

Robert is now active in Denmark, Poland and Finland, with further sales on the horizon

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New robots promise to improve spinal straightening

A precision greater than humanly possible

Report: Mark Nicholls

ScoliBot, a new robotic system, could perform spinal surgery to a higher degree of accuracy than human counterparts. Devised by a team from Nottingham Trent University (NTU), the system has two robotic arms that semi-autonomously drill holes in individual vertebrae in procedures to straighten the spines of patients with conditions such as scoliosis or kyphosis.

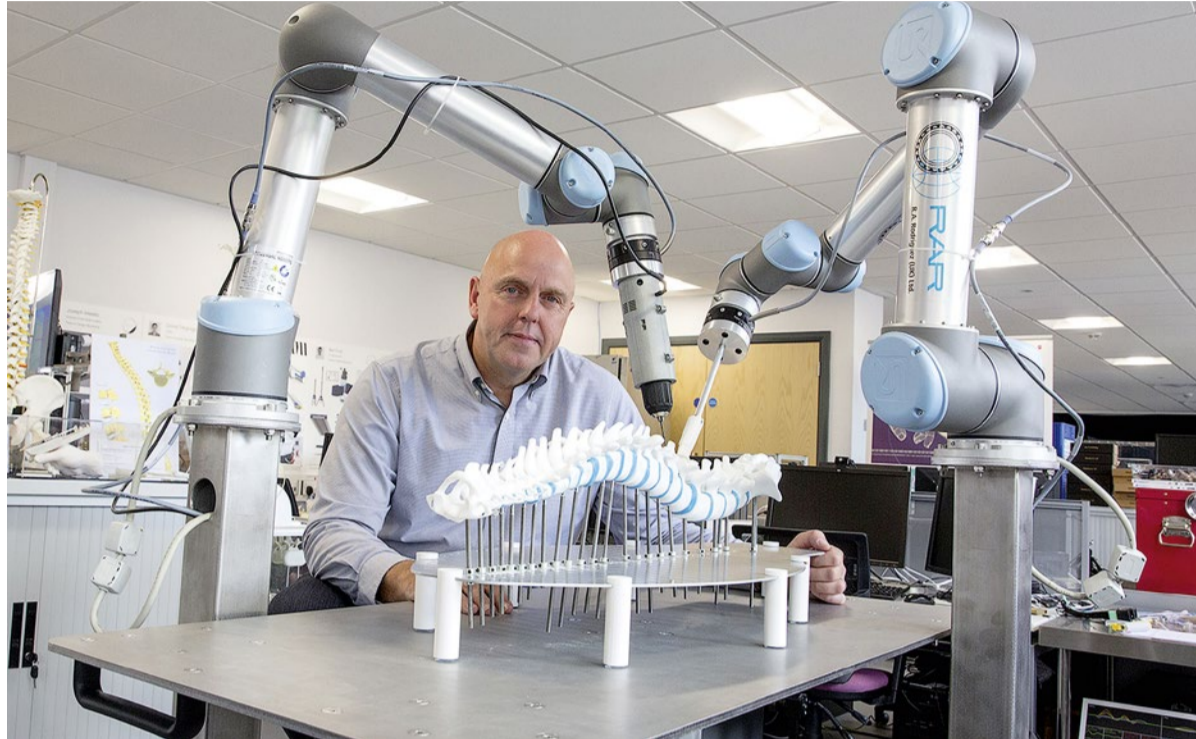
Leading the project, Professor Philip Breedon, head of NTU's Medical Engineering Design Research Group, says the technology could deliver higher levels of accuracy than achieved previously as a result of the robotic arms being able to move in unison and naturally with the patient's spine during the operation while drilling.

'Surgeons performing life-changing operations to correct spinal conditions have to ensure pinpoint levels of accuracy to avoid causing unnecessary and potentially serious injuries,' he stressed.

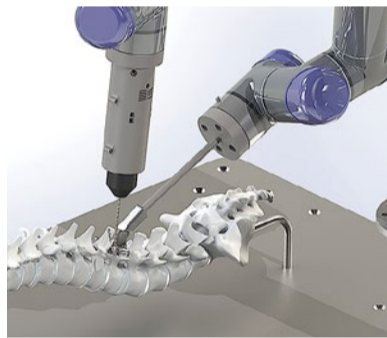
Robotic teamwork

'This technology promises to deliver greater levels of accuracy than ever previously achieved – or even humanly possible – to improve the safety and efficiency of such procedures that are needed by people with serious spinal conditions.'

The holes drilled in the vertebrae are used to insert pedicle screws, which are attached to deformity rod reducers that allow surgeons to lever individual vertebrae and realign the spine. Known as the datum and tooling robots, the two robotic arms work in collaboration during the procedure. The datum robot is secured to vertebrae and moves with them to follow the natural movements of the patient, instantly relaying data on this movement to a computer. The tooling robot then adjusts auto-



Philip Breedon demonstrating the two robotic arms for spinal surgery



Closeup of the robotic arms

matically so that it remains on its pre-defined path and continues to drill accurately.

Reduction of surgery time

The patient could benefit because the robot's reliability and precision will enable specific surgical steps to be performed more precisely,' Breedon observed. 'Ultimately, the

aim is also to reduce surgery time.'

The research also explores the use of augmented reality (AR) to provide surgeons with live visual feedback to illustrate the depth of each hole as it is drilled in real-time. Accuracy of drilling has been recorded at 0.1 of a millimetre.

'The control system will engage with the patient's body by providing a superimposed image on the surface of a patient, or in the visual field of the surgeon utilising wearable technology,' Breedon added. He is working closely on the project with Professor Bronek Boszczyk, Head of the Spine and Scoliosis Centre, Schoen Clinic, Vogtareuth, Germany, and Nottingham University Hospitals Trust UK, who explained that the system also offers potential advantages for the surgeon. 'Certain surgical

steps can be quite physical for the surgeon and fatiguing,' he said. 'The introduction of the robotic system means that surgery could be performed without any muscle tremor, very precisely and without fatigue often associated with repetitive tasks.'

Total accuracy required

'The robot, or robots, could also be useful as a "surgical assistant". This is another area of research and development we are currently exploring. It's paramount that spinal procedures are carried out with total accuracy in order to minimise what can be substantial risks to a patient. This technology has the potential to minimise those risks by performing a key part of the operation with accuracy that cannot be achieved by a human hand.'

Describing it as 'a brilliant example of how robotics can enhance and improve the way in which intru-



Philip Breedon is Professor of Smart Technologies at Nottingham Trent University and leads the Medical Engineering Design Research Group. His research interests centre on new and emerging technologies and materials, including wearables, 3-D printing of pathological models, the surgical pathway additive and subtractive manufacturing for medical applications, biomimetics, surgical robotics, and extended reality systems.



Professor Bronek Boszczyk is Head of the Spine & Scoliosis Centre, Schoen Clinic, Vogtareuth, Germany and Honorary Clinical Associate Professor at the Division of Orthopaedic and Accident Surgery and a Visiting Professor to Nottingham Trent University. His research focuses on spinal disorders.

sive operations are carried out', he said the system can improve patient safety and whilst ensuring efficiency of process.

While the development team sees the current system best linked to surgical interventions on bones, because they provide a hard interface for the robot to engage with, they also envisage that the collaborative robotic system in the future could be used in endoscopy and keyhole procedures.


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