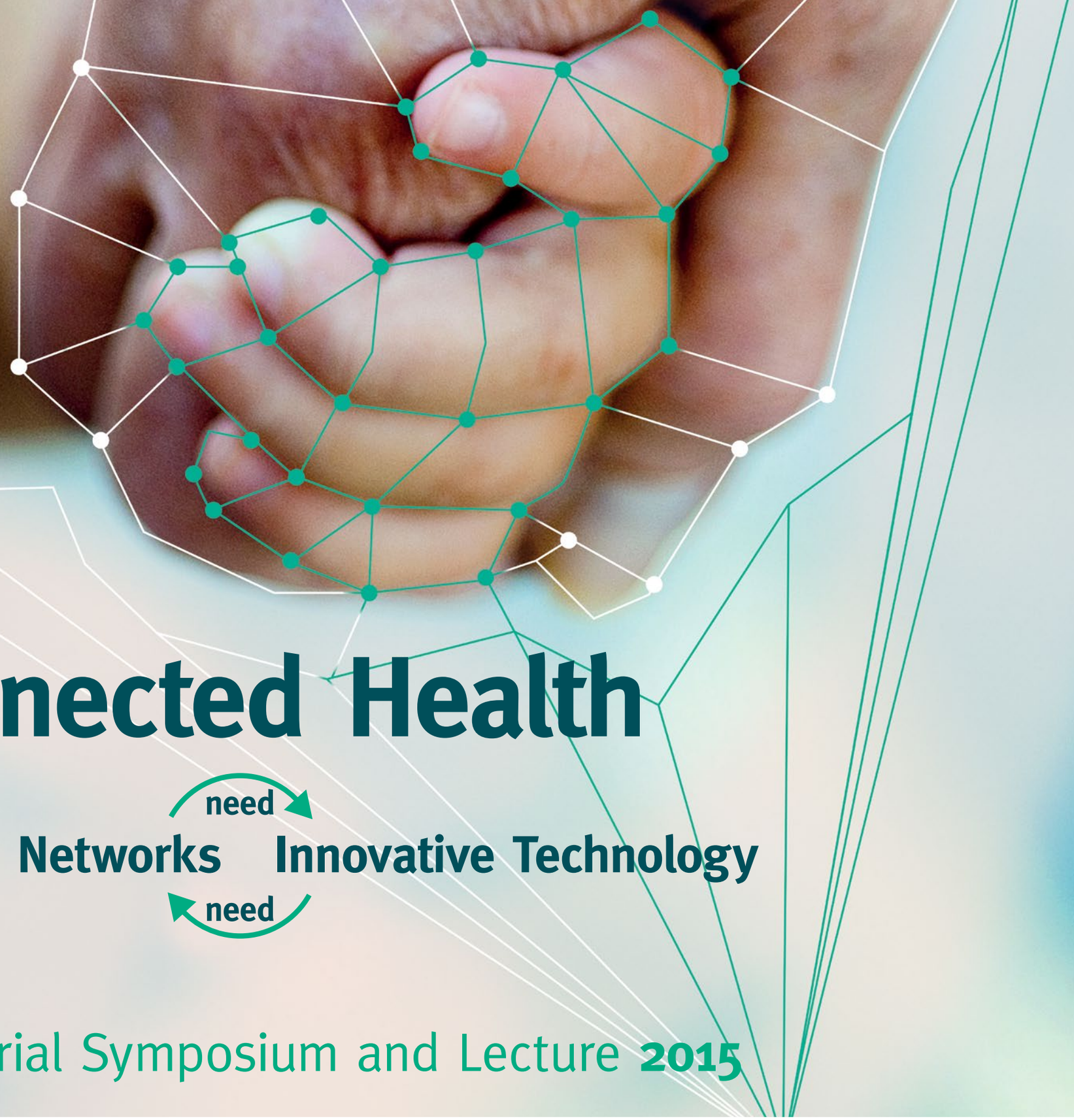

Connected Health

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Healthcare Networks Innovative Technology

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Holst Memorial Symposium and Lecture **2015**

TU/e Technische Universiteit **Eindhoven** University of Technology

PHILIPS

Connected Health

Holst Memorial Symposium and Lecture **2015**
Philips & TU/e

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Foreword

The 2015 Holst Memorial Lecture and Symposium were organized by Philips Research and Technische Universiteit Eindhoven (TU/e). On Thursday 26 November, the Holst Lecture, the 39th since 1977, was held by Prof. Bastiaan Bloem, consultant neurologist at the Department of Neurology, Radboud University Medical Center, the Netherlands. Bas Bloem is founder and director of the Parkinson Center Nijmegen. He received the Holst Memorial Lecture Award for his scientific achievements and his pioneering role in healthcare innovation.

Bas Bloem receives the Holst Memorial Lecture Award Medal 2015 from Rector Magnificus TU/e Frank Baaijens. Photo: Bart van Overbeeke.

Symposium Connected Health

The world population is aging, chronic diseases are on the rise and 75% of healthcare expenditures are spent on managing chronic conditions. Consumers want to be more in control of managing their health and need to do more themselves to keep healthcare expenditures under control. Prevention is becoming more important. Technology plays an important role in developing connected systems for continuous personal health, encompassing healthy lifestyle, effective prevention, efficient primary care and chronic disease management, with empowered consumers, patients and their caregivers. Connected Health helps us to relieve the burden of chronic disease, address the shortage of professionals, decelerate the cost increase to the healthcare system and empower people to lead a healthy life. Connected Health matches research interests of both TU/e and Philips Research.

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Healthcare Networks need Innovative Technology need

Professor Bastiaan Bloem is a consultant neurologist at the Department of Neurology, at Radboud University Medical Center, Nijmegen, the Netherlands. He received his MD degree (with honours) at Leiden University Medical Center in 1993. In 1994, he obtained his PhD degree in Leiden, based on a thesis entitled “Postural reflexes in Parkinson’s disease”. He was trained as a neurologist between 1994 and 2000, also at Leiden University Medical Center.

He received additional training as a movement disorders specialist during fellowships at ‘The Parkinson’s Institute’, Sunneyvale, California (with Dr. J.W. Langston), and at the Institute of Neurology, Queen Square, London (with Prof. N.P. Quinn and Prof. J.C. Rothwell). In 2002, he founded and became Medical Director of the Parkinson Center Nijmegen (ParC), which was recognized from 2005 onwards as Center of excellence for Parkinson’s disease. Together with Dr. Marten Munneke, he also developed ParkinsonNet, an innovative healthcare concept that now consists of 64 professional networks for Parkinson patients covering all of the Netherlands (www.parkinsonnet.nl). Because of the evidence-based quality improvement and significant cost reduction, ParkinsonNet has received multiple awards, including the ‘Pearl Prize for Best National Healthcare Innovation’ in 2011, and the ‘Value Based Health Care Award’ in 2015.

In September 2008, Bloem was appointed as Professor of Neurology, with movement disorders as special area of interest. He is currently Past-President of the International Society for Gait and Postural Research, and is on the editorial board for several national and international journals. He is currently also member of the International Executive Committee of the Movement Disorder Society. In 2009, he joined the board of ZonMw (The Netherlands Organisation for Health Research and Development). In 2011, he was elected as the National Healthcare Hero by the Dutch Ministry of Health. In 2012, he was elected Citizen of the Year for the city of Nijmegen. He has two main research interests: cerebral compensatory mechanisms, especially in the field of gait & balance; and healthcare innovation, aiming to develop and scientifically evaluate patient-centred collaborative care. Prof. Bloem has published over 550 publications, including more than 400 peer-reviewed international papers.

Prof. Bastiaan R. Bloem, MD, PhD
consultant neurologist at the Department of Neurology,
Radboud University Medical Center, Nijmegen, the Netherlands

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Technology plays a vital role in developing connected systems for continual, personal healthcare, to help relieve the burden of chronic disease, address the shortage of professionals, decelerate the cost increase to the healthcare system, and empower people to lead healthy lives. The challenge is in how best to collect, validate and share information to support this. ParkinsonNet shows how this is possible.

Innovation started by patients

Healthcare will benefit from new technology and big data. Though technology is a recurring theme it is not the core expertise of the clinician, and doctors and other healthcare professionals need motivation to start using healthcare technology.

But the technology is inescapable. Doctor Google is probably the first case of the common use of big data in medicine. More and more patients check out Google before visiting a doctor. A study from 2006 pointed out that, if the patient combines search terms cleverly, Dr. Google doesn't do such a bad job when it comes to suggesting early diagnoses and pointing patients in the right direction. Another example of data-based diagnostics involves YouTube: Dr. Andrew Lees published a paper on the onset of Parkinson's in Ray Kennedy, a famous UK football player. By analysing large amounts of footage shot throughout Kennedy's career, and found on YouTube, Dr. Lees could work out when the symptoms had started and how they had developed. One giveaway was the decrease in swinging of Kennedy's right arm as he walked.

Learning from individual creativity

But apart from tuning search terms, patients can apply creative use of technology in other ways, often finding ways of dealing with their diseases that medical professionals might never have imagined.
One man in his eighties with a severe gait disorder nailed rectangular blocks to the floor of his house. These helped him walk and exercise. Drawing or taping lines on the floor to help with walking – using a cognitive mechanism called 'cueing' – is part of the guidelines for physiotherapists treating Parkinson's patients. However, flat lines weren't helping this elderly Parkinson's patient. He needed the lines replaced by rectangular blocks, to provide depth. In similar case, another patient had great difficulty walking, but no trouble climbing stairs. By drawing 3D representations of steps on floors throughout his house, his niece who is a designer, helped him to walk around effortlessly. This shows how the brain's 'excess capacity' can be appllied.

Such examples show that professionals need to understand how patients help themselves, and how to add such innovation to their therapeutic repertoire. For example, while striped floors may be helpful around the home, they're of no use outside. A postdoctoral student at Radboud University Medical Center came up with a solution: the so-called 'cue shoe'. This attaches a laser to the patient's shoes to project a beam the Parkinson's patient can focus on, to help them walk. Around the same time, a designer in Denmark had also built laser-guided shoes for her father who has Parkinson's' disease. She won a business concept award for this, and Radboud University Medical Center is working with her and a Dutch brain research foundation to create a commercial solution. Radboud University Medical Center is also working with Google glass to allow patients to project stair-like patterns in their field of vision. This shows how technology in healthcare creates unique opportunities for public-private partnerships.

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Creating a continuum of care

A sobering piece, published in The Lancet Neurology, compared outcomes for patients of the Parkinson Center at Radboud University Medical Center – one of just three European Centers of Excellence recognised by the Parkinson Foundation – with three “normal” centers: Patients at all locations seemed to be doing equally well. This highlighted that patients with Parkinson’s embark on a journey filled with dead ends, warning signals and red traffic lights. Nobody has a complete route description. Visiting a medical center is just one stop on this long and complex trajectory. Fortunate patients will have doctors that take them to the station and help them board the train. However, the decisive difference is made by providing help all the way, in the patient’s community, and where they live.

Even patient’s leaving Radboud University Medical Center need continual support from care workers who carefully follow the advice and recommendations from the Parkinson Center. When that doesn’t happen, the chain is only as strong as its weakest link. Coupling this to financial outcomes can create accountable organisations that involve the hospital, the community, the nursing home, to become collectively responsible for good results. A specialist on their own little island poses a threat to healthcare. This is where technology becomes a great way of collecting, analysing and sharing ideas.

This was the motivation for the team at Radboud University Medical Center to develop ParkinsonNet. This is a platform that brings patients and health professionals from 12 disciplines together to share experiences, knowledge and questions, in networks that transcend traditional barriers in healthcare. Concentration of care is important. That is, apart from sharing information, there are people in the networks who build specialised expertise by attracting a high caseload of Parkinson’s patients. But the central principle is to engage patients as serious partners in their own healthcare. Care should be through self-management at home, with the care in the hospital when there is no alternative.

Technology can support all this, but should never be a goal in its own right. Often, healthcare invests in new devices and then works out what to do with them, instead of first developing a vision and then looking for equipment to realise it. Simple measures can help, too, such as Prof. Bloem’s consultations not taking place across a desk, allowing patients sit where they like. He gets the patients’ coffee too. Basic hospitality and a lack of hierarchy ease the pressure on the patient.

ParkinsonNet in the Netherlands has 68 regional networks, centred around hospitals. It also includes ParkinsonConnect, a Facebook-like platform that brings 3,000 people together to exchange experiences, knowledge and guidelines, and to ask questions. One example is of a physiotherapist looking for a computer mouse for a patient with a severe tremor. Fifteen minutes after raising the issue, he had a response: a special mouse developed by the gaming industry. These people wouldn’t have been able to find each other before. Now, the solution is even stored for future reference.

Benefiting from practices internationally

There’s much international interest in ParkinsonNet. The British Medical Journal described it as ‘revolutionising the treatment of chronic disease.’ And it is already in use beyond the Netherlands: in parts of Germany and in California. On a recent trade mission to the USA, ParkinsonNet signed a memorandum of understanding at the Van Andel Institute in Michigan, who would be the first paying client, with any profits being reinvested in healthcare.

While the basic ingredients are constant – because the needs and wishes are the same everywhere – the practices, use and presentation are different in different countries. Germany has specialists working in the community, rather than just clinics, and the chain of hospitals in California has almost no home or community care. Kaiser Permanente in California introduced a new element, taken from industry: setting up a ‘voice of the customer’ programme. This provides topics for the patient to speak about freely, without interruption from an interviewer.

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This can provide unexpected insights. One lady had been a patient for over 12 years, visiting a Parkinsons-specialised nurse practitioner six times a year. Her care team presumed they knew her and her concerns well. But in her voice of the customer interview she surprised everyone when she revealed that her dream was a tandem so she could go out cycling with her husband.

Empowering patients

Apart from best practices shared across borders, a panel of ParkinsonNet patients evaluates other new ideas. These include a web-based healthcare finder (parkinsonzorgzoeker.nl and parkinsonsuchmaschine.de) to help patient see the details – and track record – of healthcare professionals in their vicinity. It also includes a monthly live TV programme in the Netherlands, presented with a patient, on topics determined by a patient panel. This is driven by the belief that the more people can be helped at home, the less they feel like patients. The TV programme communicates and educates, without patients having to attend the hospital. Other initiatives include work with the Eindhoven University of Technology (TU/e) to develop wall-mounted cameras to identify Parkinson-like behaviour in the home, rather than needing people to attend sleep clinics for observation.

Another interesting partnership, with Philips, involves wearable sensors, such as the Philips Lifeline. Combining these with other sensors, such as a smart-phone or –watch helps researchers understand how patients comply with wearing multiple sensors, how data can be used to personalise treatment, and how to create a 'personal dashboard'. To use a car analogy: patients could get alerts telling them when they need to top up their window-cleaner – something they can do themselves – or when they should go to the "garage". That is, closer monitoring and clear escalation criteria can ensure people don't need to go to hospital unnecessarily.

A small-scale study in the US also showed the benefits of technology that allows doctors to perform virtual 'house calls'. The patient got more time speaking to the doctor, and the doctor saved time by not having to travel. Patients enjoyed the virtual method, and health outcomes were identical. This can be important in a country like the USA, where many Parkinson's patients never see Parkinson's specialists because of a lack of access, due to their location. Such patients were more likely to sustain injuries or end up in hospital.

Overcoming barriers beyond the technology

As ever, the big question is: who will pay? Discussions with insurance companies often falter at the initial incremental cost, though patients have signalled their interest in buying helpful equipment. Radboud University Medical Center is running an experiment in the Nijmegen region with two major insurance firms to receive a fixed fee and assume responsibility for the whole healthcare chain. Responsibility for the budget lets the clinician decide what will create the best, most cost-effective, overall outcomes.

Networks such as ParkinsonNet are proving to have greater intrinsic value than expected. They can optimise care, reduce healthcare costs, and provide a test bed for clinical trials, with access to experts who can successfully carry out studies. For example, ParkinsonNet is reducing hip fractures by 50% in the Netherlands. It's reducing healthcare costs by 20 to 30 billion Euros each year.

The board of ParkinsonNet is challenging IT companies to build equipment that can help the network work better, and help patients manage themselves. To bring care closer to home ParkinsonNet wants to engage patients and discover their real wishes. For example, ParkinsonNet is researching with Philips how off-the-shelf technology can help motivate patients to move. Such solutions will help shift the role of the doctor away from dictating what patients want, towards giving patients room to identify their own needs. Technology is a vital part of achieving such goals.

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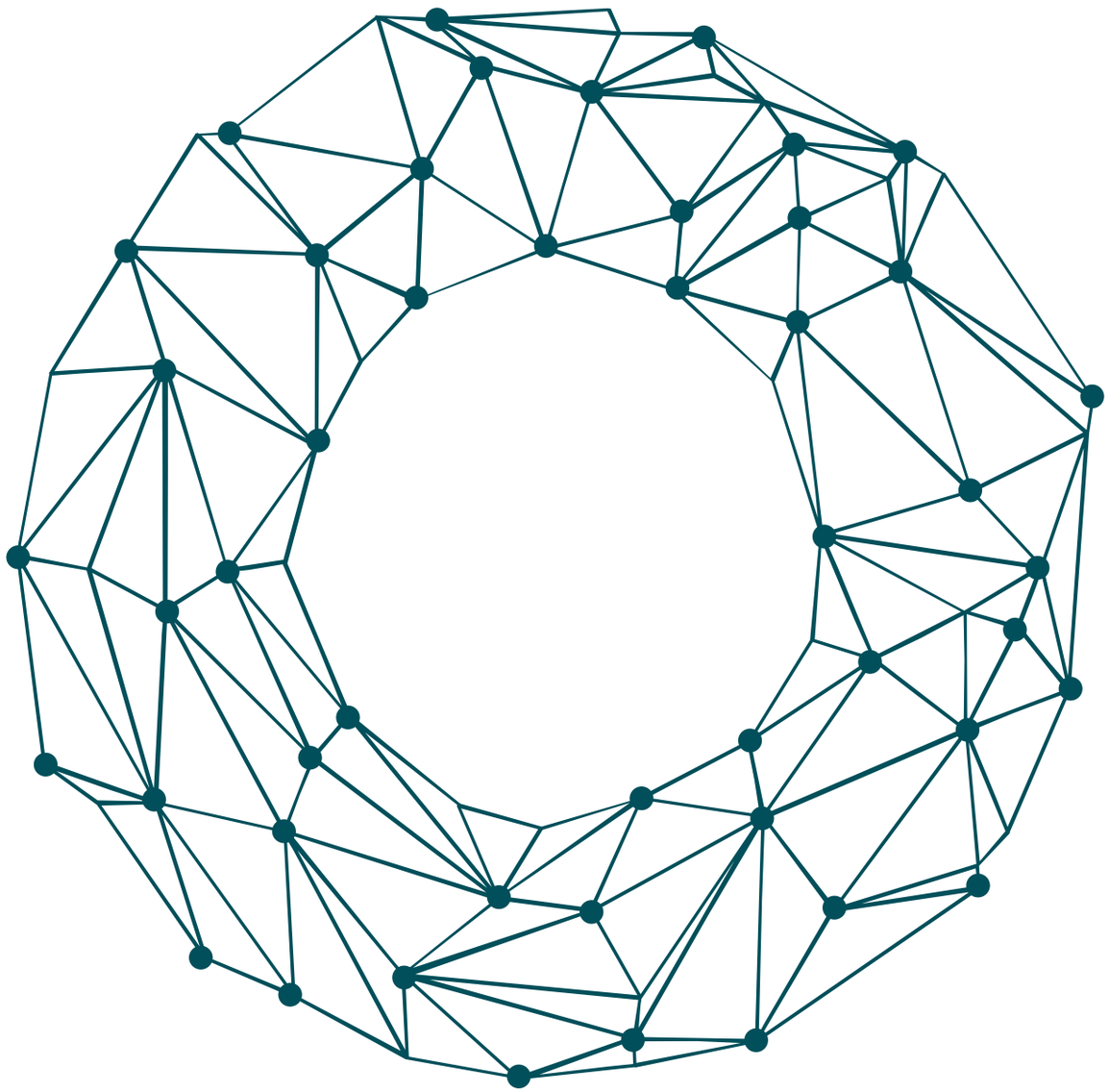
Thanks

Prof. Bloem would like to thank the Department of Neurology and his entire team at the Parkinson Center at Radboud University Medical Center, and in particular Ronald Lolkema and Marten Munneke of ParkinsonNet, Thea van Kemenade and Tessa van der Zanden, who help build public-private partnerships, Milou van Rijswijk, his personal assistant, and his family, Jochem, Douwe and Inge.



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‘Stop Talking, Start Doing’

Lucien Engelen
Director REshape Center for Innovation at
Radboud University Medical Center, Nijmegen

Lucien Engelen has been Head of the Regional Emergency Healthcare Network at the Radboud University Medical Center in Nijmegen since 2007. He also advises the Executive Board on responding to changes in healthcare and enhancing patient participation in health, research, and education. Engelen is founding Director of the Radboud REshape Center for Innovation, an initiative set up to address the growing challenges in healthcare through innovation and rethinking the role of the patient. The program is committed to driving the development of Health 2.0 through a participatory approach. To this end, it has established alliances with leading technology partners including Philips, creating solutions designed to put the patient (as a partner) front and center.

In addition, Engelen is Chief Imagineer at the National IT Institute for Healthcare in the Netherlands, NICTIZ, and a member of the Exponential Medicine faculty at the Singularity University, Silicon Valley. LinkedIn named him as one of the 150 world thought leaders and invited him to blog as part of its Influencers program. Engelen has also featured in Dutch national-TV future-affairs show Backlight (Tegenlicht), where he shared his vision and approach to healthcare. He has written a number of books, essays, chapters, and scientific papers on changes in healthcare. In 2015, he received the Radboud Medal 2015, the Dr. Michael Medal, awarded by the Dutch Surgery Association, and the TIM 2015 for most inspirational leader in IT, awarded by ICT Media and the Dutch CIO Magazine.

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Healthcare faces myriad challenges, including increasing demand, shrinking budgets and personnel shortages. To address these new and rapidly evolving issues will require a fundamental rethink of roles. In the past, medical decisions were traditionally in the hands of physicians, caregivers, and other professionals. But the rise of technological innovation is opening up a world of possibilities, helping find answers to many of today’s challenges – and putting patients where they belong: at the heart of healthcare.

REshape Center for Innovation

Today’s rapid evolution of disruptive innovations is commonly expressed as exponential technology. In the five years since the REshape Center was established at Radboud University, technology has been accelerating continuously. But there is another driving force in healthcare which is even stronger and perhaps even more exponential: the patients themselves. And it is this element that has potential to change the world.

Against this background, the REshape Center has formed a number of alliances. Working closely with these partners, the staff and students at REshape aim to make tangible differences to healthcare – or rather to health itself.

One goal of the Radboud University Medical Center, for instance, is to reduce the number of beds from the current 1,000 to 500 in the next ten years. The aim is not, however, driven by cost-cutting but by a desire to empower patients to effectively manage their own health outside of the traditional hospital setting.

The past, present, and future of healthcare

Back in 2010, when REshape was founded, the concept of Health 2.0 was just emerging in the United States. The term is most commonly used to describe greater engagement and interaction between patients and caregivers, enabled by modern technologies. Logically, then, we should refer to the era directly preceding this as Health 1.0, a time characterized by traditional, one-sided patient/physician encounters with doctors issuing advice, and patients simply following it.

It is this traditional approach to healthcare that has dominated much of history. Physicians in Ancient Greece, for example, who took the Hippocratic Oath were seen as having godly powers. Yet, the patient’s role was small and insignificant. For centuries, the attitude of medics remained: keep the patient uninformed and if you don’t know what the problem is, keep quiet.

Sir Luke Fildes’ 1887 painting The Doctor’s Visit illustrates the physician-patient-family dynamic of the day. It depicts a doctor treating a sick child,

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while in the background the father consoles the weeping mother as they wait for a decision. The protagonist of this well-known piece is clearly the doctor who is in the foreground and illuminated. The young patient herself receives a lesser level of attention and the parents are barely noticeable.

Today, however, the emphasis is shifting and medicine is becoming more participatory, with all stakeholders working to find solutions and make decisions together. In the future, this will develop even further – changing from participatory medicine to participatory healthcare.

The fourth industrial revolution

Many of these changes will be made possible by digital technologies. The internet has already altered the face of the music industry, the travel sector, and many others – and now it is set to turn healthcare on its head, too. The fourth industrial revolution is well underway and the internet of things – or rather the internet of everything – is becoming a reality. We can no longer expect small waves of innovation but a true tsunami.

Today, speed is the name of the game. Fast companies are overtaking slow ones and agility is paramount. But it is not simply about technology: these innovations will call for widespread societal and legislative changes, and force us to rethink healthcare as a whole.

A world of possibilities

In the next five to ten years, healthcare will evolve rapidly. Many of the innovations and tools that were considered futuristic just three years ago are already making a difference to people’s lives today.

REshape Center that is part of Radboud University Medical Center is working on a number of solutions that will support patient-driven care and empower people to take greater control of their own health.
A specially designed, low-cost stick, for example, can give accurate urine-sample results for a number of illnesses in around 60 seconds – from the comfort of the patient’s home. Similar finger-prick devices for blood testing are also under development.

Another state-of-the-art device placed between the finger and the forehead measures blood pressure, heart rate, skin temperature, and blood oxygenation in a fraction of the time it would take to make these readings in a conventional hospital setting. And a smart band aid worn by the patient takes EKG readings, heart rate, temperature, respiratory rate and validated EKG measurements for five consecutive days. The captured data is subsequently sent wirelessly to a 3D printer which prints a customized pill in line with the patient’s specific needs on a given day.

Sharing is caring

Modern technologies will also revolutionize the way we communicate and share our data with doctors and others. REshape innovation FaceTalk is a secure video platform that supports remote consultations between patients and physicians, eliminating the need for direct contact at least in the first instance. The Dutch Ministry of Health has already recognized this service and made it reimbursable. Within the next four years, everyone in the Netherlands should have access to this or a similar video platform.

A REshape concept called Hereismydata™ gives patients autonomy over their medical data, empowering them to decide who they would like to share it with. Healthcare institutions are used to transferring data back and forth, but very often the patient is left out of these transactions. The concept is designed to close this gap, by giving people more control over their own personal data.

The delocalization of healthcare

As visits to medical centers become less frequent, one possible substitute is the local supermarket. These amenities are accessible and already play a significant part in people’s daily routines. Combining a health check with the weekly grocery shop saves time and effort and can reduce the stress of a doctor’s visit. Robotic systems located in a dedicated area of the store will be equipped with the technology needed to take basic measurements and share results, without the involvement of a doctor or nurse. Innovations such as these are expected to hit the market soon, making healthcare a more central part of day-to-day life.

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Smart shopping carts will also be able to give nutritional advice based on the shopper’s personal health data. Embedded electronic chips will read up-to-date statistics stored in an app, and make suggestions for appropriate food and drink choices.

Self-service and self-help are fast becoming the norm. In fact, calculations predict that in just seven years’ time, 70% of the routine examinations performed at Radboud University Medical Center will be carried out elsewhere – whether that is in the patient’s home, at a supermarket, or other public place.

Patient-centric innovation

Another key change is that patients are being more heavily involved in the creation of new technologies. In the past, systems were designed based on what professionals thought the users wanted. Nowadays, innovation happens hand in hand with the patients and their families. Developers listen to suggestions and propose answers to acute needs.

REshape and Philips share a similar vision in this respect, working to bring the patient to the fore. The partnership has already borne fruit in the form of a COPD monitoring solution and a system for managing type 1 diabetes. These two projects drew on real-life experiences to develop flexible solutions that can be easily tailored to individual patients and their healthcare challenges. Philips partnership with Amazon will also enable telemedicine and telehealth offerings based on internet technologies.

By contributing their data, patients are becoming participants and not just respondents of medical research, playing a more active role than ever before. A new platform called MedCrowdFund set to be launched in 2016 will allow patients to share details about their illnesses and define research questions that they think are useful. This information can then be used to crowdsource research opportunities from the patient perspective.

Bring-your-own patient (BYOP)

The right education and training for medical professionals is an important part of the equation. To this end, Radboud University Medical Center has recently introduced topics such as e-health, social media, and other modern developments to its curriculum. Although it will take several years before the 450 current first-year medical students have any real influence, it is vital that they are equipped with these skills early on.

Furthermore, a “bring-your-own patient” initiative where students are being asked to follow a member of their own family on their personal healthcare journey is helping to cement the patient-centric approach and change thinking among these physicians of the future.

Turning ego-systems into eco-systems

Some healthcare professionals have voiced concerns over whether patients are up to the challenge of managing their own data. But in many cases, there is no one more suitable for the task, since patients have direct access to the necessary information.

Digitization and patient inclusion are important steps in reshaping and reforming the healthcare environment. The doctor-centric ego-systems of the past must be replaced by true eco-systems that recognize and embrace patients as valuable partners.

Patients must be at the heart of healthcare. Instead of simply talking about it, we need to start making it happen. The healthcare industry faces a long and bumpy road: there is lots of work to be done – but a great deal of potential out there, too.

Telehealth-Enabled Care: Preparing for the New Landscape of Healthcare

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Julie Reisetter MS
Chief Nursing Officer for Telehealth at Banner Health,
Phoenix, Arizona, USA

Julie Reisetter has over 30 years of healthcare experience in a variety of roles throughout the U.S. Her professional journey has included clinical and leadership positions in Iowa, Colorado, California and Arizona. In 2011, Julie was selected as Banner Health's first Chief Nursing Officer for Telehealth Services where she is responsible for the development, implementation and sustainability of innovative Telehealth solutions across the care continuum.

Banner Telehealth currently provides critical care services to patients in over 450 beds at 24 facilities across 5 states. In addition, Banner TeleAcute services are available at three full surveillance facilities: Banner Gateway, Banner Ironwood and Banner Ft Collins. In 2013, Banner partnered with Philips to develop the Intensive Ambulatory Care program. Branded Banner iCare™, the service is currently providing innovative Telehealth services to over 600 complex, chronic patients in their homes. Ms. Reisetter's educational background includes a Bachelor of Science in Nursing from the University of Iowa and a Master's in Science from the University of California -San Francisco.

"As the world changes and reimbursement for healthcare moves away from a fee for service, Banner Health wanted to be one of leaders who would help design healthcare for the future."

Julie Reisetter MS
Chief Nursing Officer for Telehealth at Banner Health,
Phoenix, Arizona, USA

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Headquartered in Arizona, USA. Banner Health is one of the five largest non-profit healthcare systems in the country. In 2006, the system decided to invest in telemedicine, first rolling out a program in the ICUs and later expanding it to the general ward. In 2013, an innovative telemedicine program was implemented for the sickest of ambulatory care members. This program has enrolled over 1000 members and currently serves over 600 patients. Cost savings and quality measures have been impressive in all these telemedicine initiatives however the returns on telemedicine go beyond tangible measurements. Banner Health also benefits from the multiple ways this delivery models breaks down geographical and systematic barriers between healthcare providers and their patients.

The challenge: rethinking the delivery model for care

Banner Health was one of the first healthcare organizations in the United States to become an accountable care organization (ACO). ACOs are groups of doctors, hospitals, and other healthcare providers which join forces to offer coordinated, high-quality care to Medicare patients. (Medicare is a national social insurance program administered by the U.S. federal government.) When ACOs demonstrate they deliver high-quality care and make intelligent use of their budgets, they share in the savings they achieve for the Medicare program. In terms of cost structures, this move meant that Banner Health would move away from service-based fees and toward reimbursement based on value provision. In year 3 (2014), Banner returned $29 million in savings over predictions while at the same time improving its quality score by nearly 10%.

The decision to work with Philips

Telemedicine designed for success calls for an entirely new constellation of people, processes, and technology. How, for example, will specialists in different parts of the world work together – and with caregivers at the bedside? What devices and systems will be used when? Are they suited for virtual workflows? Whether it was implementation of the TeleICU program or developing the ambulatory pilot program, Banner Health turned to Philips for support in structuring workflows as well as creating and adapting algorithms within devices and systems essential to patients and care providers in those settings.

Making telemedicine a reality in the ICU: TeleICU

Banner Health's telemedicine journey began in the high-cost, high-risk ICU. Utilizing sophisticated Philips eCareManager software and wall-mounted two way audio/video cameras in every ICU room, Banner employs a virtual team, including Intensivists and critical care nurses, who provide live support to the bedside care team. These virtual teams, in neighboring states and areas as far away as Israel, obtain alerts via interfaced data captured by the algorithms in the Philips software. This data is used to identify adverse patient trends and intervene before the patient's condition worsens. Another aim of this expansive service is to decrease variability in care delivery while increasing reliability.

"Telemedicine is an integral way to provide healthcare for the future."

Julie Reisetter MS
Chief Nursing Officer for Telehealth at Banner Health,
Phoenix, Arizona, USA

Although telemedicine technology is now a standard component of Banner Health's critical care services at 24 facilities across five states, the program was rolled out slowly but steadily to address financial concerns. As healthcare moves from volume to value, Banner's mission to reduce mortality and hospitalization, becomes even more important.

2014 Banner Critical Results
(for patients with a portion of their stay in an ICU):
- **1890** lived saved*
- **46,435** fewer ICU days*
- **45,861** fewer hospital days*
- **$109 MILLION** in length of stay cost avoidance

Banner Health at a glance

Banner Health owns and operates 28 acute-care hospitals, Banner Health Network, Banner – University Medicine, Banner Medical Group, long-term care centers, outpatient surgery centers and an array of other services, including family clinics, home care and hospice services, pharmacies and a nursing registry. Banner Health is active in seven states.

Banner Telehealth at a glance

Banner Telehealth currently provides critical care services to patients in over 450 beds at 24 facilities across five states in the United States. In addition, Banner TeleAcute services are available at three full surveillance facilities: Banner Gateway, Banner Ironwood, and Banner Ft Collins. In 2013, Banner partnered with Philips to develop the Intensive Ambulatory Care program. Branded Banner iCare™, the service currently provides innovative telehealth services to over 500 complex, chronic patients.

Applying TeleICU insight to the general ward: TeleAcute

The success of the TeleICU program paved the way for TeleAcute – a similar concept retooled to the needs of the general ward. Not only was Banner Health eager to extend lessons learned from TeleICU to TeleAcute, the organization has seen great potential in wearable devices for patient monitoring. At the moment, general ward patients at Banner Health facilities wear telemetry packs to monitor parameters such as EKG, Heart rate and SpO2. While these devices may be perceived as bulky, patients have understood that the underlying technology concept ultimately helps them go home earlier.
Philips technology played a key role in improving patient care in the Banner Health general ward. Through the combined research efforts of Philips and Banner, there are indications that when continuous monitoring is implemented, along with a dedicated team and Philips software, there is an ability to detect deterioration much earlier, reduce complications and reduce the length of patient stays.

Success in the general ward:
- **17%** shorter length of stay
- **54%** fewer transfers to the ICU
- **36%** fewer falls

Expanding telemedicine into the comfort of home: Banner iCare™

Armed with the experience of the TeleICU and TeleAcute programs, Banner Health was ready to move telemedicine into the home with Banner iCare™ Intensive Ambulatory Care, an initiative focusing on the most complex and highest cost patients – the top 5% of patients. In this scenario, patients are living with multiple chronic conditions, such as congestive heart failure or COPD compounded by diabetes. The launch of Banner iCare™ demonstrates how high-touch and high-tech collaborative care can be.

* As compared to APACHE prediction benchmark data

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The program makes technology accessible right in the home. Participants receive a personal health tablet and other home health tools to help them collect objective and subjective information on their health and facilitate two-way audio/visual “visits” with their virtual care team. This process also allows Banner Health to learn more about overall patient engagement and what psycho-social services help telemedicine succeed. Thanks to this technology, patients enjoy streamlined access to care.

Banner Health, once again, worked with Philips to develop the people, processes and technology to address the needs of this challenging population. Instead of critical care nurses and physicians, the Banner iCare remote team includes primary care physicians, nurses, social workers and pharmacists. Careful investigation revealed the importance of pharmacists and social workers for this group of patients. For several reasons, patients in this group may share their medication, not get their medications due to finances or take them in incorrect dosages. Pharmacists and social workers joined the care team to educate these patients on the importance of medication compliance. What’s more, these specialists can help patients find appropriate alternatives for getting medication when travel isn’t possible.

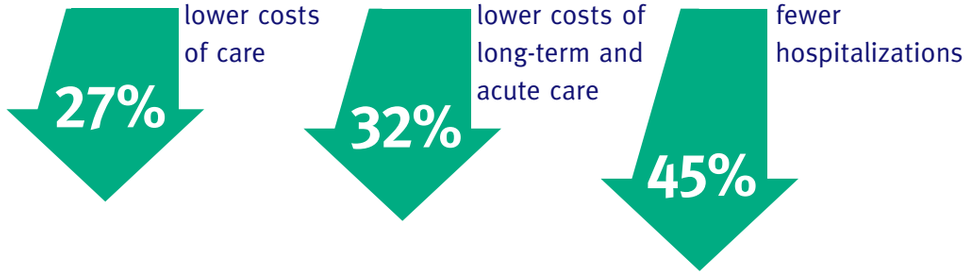
“Health coaches” act as the linchpin in Banner iCare™. By spending time with patients in their homes, health coaches conduct point-of-care testing and learn about the issues that matter most to patients. They are trained in motivational interviewing skills and offer guidance on setting goals for these members in an effort to measurably improve their quality of life. As the only telehealth team member to enter the patient’s home, a health coach breaks down barriers between patients and healthcare systems, making sure important information that would otherwise go unrecorded is relayed back to the larger caregiving team.

Data and telemedicine

Data has the power to unlock clinical insights and improve standards and delivery of care. But as is the case in so many other disciplines, the sheer amount of data available can be overwhelming. Banner Health faced several challenges in identifying data that would define “success” in telemedicine. When, for example, would outcomes be evident? When is the right time to begin measurement – at enrollment, or when the equipment is delivered?

Banner Health collaborated with Philips through several iterations to produce reports that provide the right data in the right areas.

The results for patients with one year of data speak for themselves:



Clinical Decision Support Systems & Connected Health

4

Bart De Moor
Full professor Department of Electrical Engineering ESAT-STADIUS, KU Leuven and Scientific Director of the iMinds Future Health Department

Bart De Moor (*1960) obtained his Master Degree in Electrical Engineering in 1983 and a PhD in Engineering in 1988 at the KU Leuven. For 2 years, he was a Visiting Research Associate at Stanford University (1988-1990). Currently he is a full professor at the Department of Electrical Engineering in the research group STADIUS and the Scientific Director of the iMinds Future Health Department. His research interests are in numerical linear algebra, algebraic geometry and optimization, system theory and system identification, quantum information theory, control theory, datamining, information retrieval and bio-informatics (see publications on www.bartdemoor.be).

He is or has been the coordinator of numerous research projects and networks funded by regional, federal and European funding agencies. Currently, he is leading a research group of 10 PhD students and 4 postdocs and in the recent past, about 80 PhDs were obtained under his guidance. His work has won him several scientific awards (Leybold-Heraeus Prize (1986), Leslie Fox Prize (1989), Guillemin-Cauer best paper Award of the IEEE Transactions on Circuits and Systems (1990), Laureate of the Belgian Royal Academy of Sciences (1992), bi-annual Siemens Award (1994), best paper award of Automatica (IFAC, 1996), IEEE Signal Processing Society Best Paper Award (1999). In November 2010, he received the 5-annual FWO Excellence Award out of the hands of King Albert II of Belgium. Since 2004, he is a fellow of the IEEE (www.ieee.org). Since 2000 he is member of the Royal Academy of Belgium for Science and Arts.

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Neither automated technologies nor the engineers who design them will ever replace the hands-on experience of medical doctors. However, these technologies can offer crucial support to medical professionals in clinical settings, and will play increasingly important roles in the future of medicine and healthcare.

Prof. De Moor's research group seeks to support innovation in healthcare by providing healthcare solutions to professionals, patients and policy makers. This is achieved by leveraging the power of co-called "serious" data, that is, data that requires an in-depth understanding of the field of application, in this case, medicine and healthcare. Innovation in this area is driven by a growing focus on personalization, prevention, prediction, and patient participation, and by multiple societal trends including demographic changes, a greater demand for better quality of life, and increased connectivity.

Technological progress as a driver of innovation

A major factor enabling these advances is today's rapid rate of technological progress. Take for example the growing field of omics, which analyses the roles and relationships of the disparate molecules that comprise the organism. For example, genomics technologies include DNA chips (or microarrays), which identify patterns of gene activation both in healthy individuals and in specific cancers, and allow researchers to obtain a specific genetic "fingerprint" for individual tumours using biopsied tissue. Mass spectrometry, another powerful analytical tool, is used to image and characterize the chemical composition of tumour tissue, and can produce 3D images of entire brains or be used to model tumour evolution over the course of treatment. In addition to their immediate diagnostic functions, these technologies produce massive amounts of medical data, which in turn can be integrated into decision support systems and analysed to identify interactions between genes, proteins, and other molecules, as well as the influence of the environment on each of these parameters.

The rate at which these and other technologies progress is illustrated by the example of human genome sequencing; every year, the cost of this procedure decreases by 50%, while the efficiency with which it can be performed doubles. Thus, a task that the first time round cost $300 million and took 13 years may be performed within 24 hours for less than $100, within a few years, paving the way for full genome sequencing as a standard procedure for all newborns. The storage and processing of these huge amounts of data is made possible by parallel advances in computer hardware: Moore's law describes an exponential increase in the computer processing capacity, which doubles every 18 months.

Bottleneck

The breakneck pace of technological progress is thus producing huge amounts of increasingly complex data. However, a bottleneck arises in this scenario at when that data needs interpretation. Enter the data engineer, whose job it is to parse and fuse data from multiple sources, to translate it into a language that medical professionals can understand, and ultimately act on. This is achieved through the development of algorithms: machine-learning techniques that model and cluster data and are central to the creation of clinical support systems.

Here, the true complexity of dealing with the tsunami of medical data becomes evident. Data collection is the easy part, but to use data to effectively answer specific medical questions, it must be rigorously processed. The analyst's first challenge is to ensure that data itself is "clean". Medical data is often collected using different types of equipment, which gives rise to significant variability in baseline values and problems of normalization. Once this pre-processing is complete, engineers use a variety of methods to interrogate the data, including feature detection, clustering, longitudinal modelling, and visualization. Perhaps the ultimate challenge for the engineer is to effectively fuse multiple sources of data in a comprehensible way, such that they can then be interpreted by the medical professional who can take the appropriate action.

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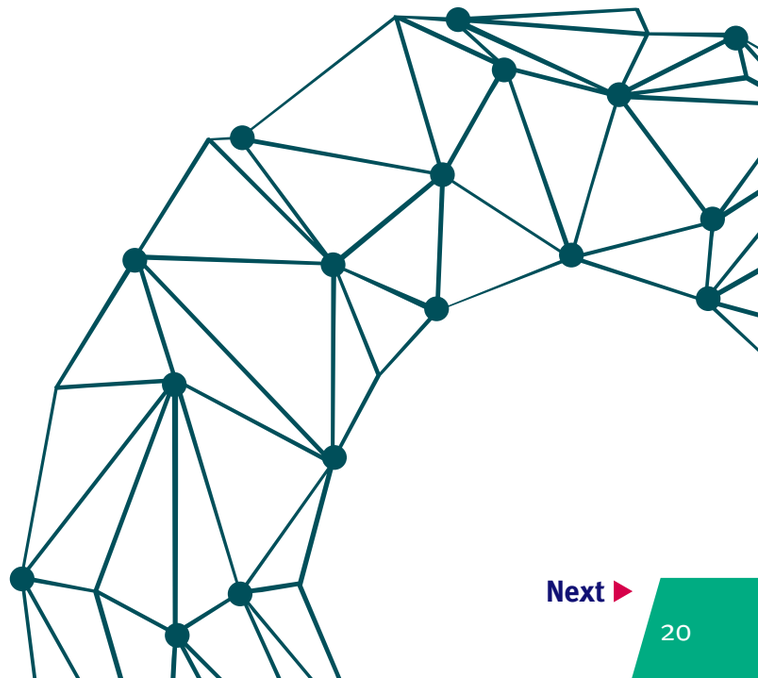
This approach is used in gene prioritization studies, whereby genetic data from multiple sources, including DNA chips, text sources, and animal models, are combined to provide a ranking of selected genes in terms of their relevance to a pathological process of interest.

Putting theory into practice

Collaborations between Prof. de Moor's research group and almost every department in KU Leuven have resulted in many clinical decision support systems that are currently in use today. For example, the International Ovarian Tumor Analysis (IOTA) project provides medical professionals worldwide with direct access to a database of ovarian cancer patients, including ultrasound data and information on tumour characteristics and blood levels of tumour markers. Data from new cases can be immediately compared, contrasted, and correlated with the contents of the database to improve diagnosis. Crucially, the growth of this database correlates with increased diagnostic accuracy, demonstrating the validity of the underlying machine-learning algorithms, and emphasizing the importance of sharing medical data while maintaining patient privacy.

Another system is LOGIC-INSULIN, an automated glycaemia control system designed to monitor patients in intensive care units, a task usually performed by a nurse who may be responsible for up to 30 patients. This clinically validated software senses patients' blood sugar levels and modulates them accordingly, ensuring tighter control of blood glucose, decreasing mortality, and improving patient safety. The incorporation of microarray technology into clinical decision support systems has identified three different patterns of gene activation corresponding to distinct forms of the disease. Blood samples from new patients can thus be analysed by and compared with the patient database to determine whether the observed pattern corresponds to one of the previously identified patterns.

While the majority of such technologies provide healthcare solutions for medical professionals, their potential can only be fully realized by complementary innovation at the level of healthcare policy. One such example is the mining of healthcare billing data, which can provide a measure of general physical condition and identify risks of certain diseases such as diabetes. A more ambitious proposal is to apply data mining techniques to the Belgian national social security system, which has an annual budget of €25 billion, thus bringing about significant savings in healthcare expenditure. In contrast to innovation at the professional level, these approaches face much stiffer resistance due the large number of competing interests and the country's heavily politicized healthcare system. Nonetheless, the continued application of innovative approaches to leverage data at all levels of healthcare, from primary care to policy, is one of the keys to addressing the challenges faced in healthcare in the 21st century.



5

Leading Digital Transformation

Jeroen Tas, Msc
CEO Healthcare Informatics Solutions and Services,
Royal Philips Electronics

Jeroen Tas has over 30 years of global experience as an entrepreneur and senior executive in the healthcare, information technology and financial services industries. Currently he is the CEO of Healthcare Informatics, Solutions and Services at Philips. In his current role, Jeroen is committed to creating new models of people-centric healthcare, based on the power of technology. Previously he was the Group Chief Information Officer (CIO) of Royal Philips, leading IT worldwide. Jeroen and his team have evolved IT to become a fundamental enabler of growth for Philips as a real-time, connected company. He co-founded and served as President, COO and vice-chairman of the Board for MphasiS, an IT and Business Processing Outsourcing company with revenues of $1+ billion, which was acquired by EDS (an HP company) in 2006. From 2007 to 2008 he was Vice President and General Manager at EDS, responsible for the global competency centers. Prior to MphasiS, Jeroen was the head of Transaction Technology, Inc., Citigroup's tech lab, responsible for the innovation and development of the bank's customer-facing systems. Earlier in his career, he held international marketing and project management roles with Digital Equipment and Philips in the USA, Europe and Asia.

Jeroen is the 2004 winner of the E&Y Entrepreneur of the Year Award in the Information technology category for the New York region. He also won the Dutch CIO of the year 2013 Award, NASSCOM Global CIO Award 2014, the World Innovation Congress 2014 CIO Leadership Award, CIO Net European CIO of 2014 Award and the IT Executive 2014 Award. He is a native of the Netherlands and holds a Master's Degree in computer science and business administration from the VU University, Amsterdam.

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A glance at global disease statistics indicates that we are facing an imminent healthcare crisis, exacerbated by an aging population and an increasing burden of disease. Half a billion people have or are at risk of developing diabetes. Over 1 billion suffer from neurological disorders. These are not rare diseases, and much is known about their treatment and prevention. Nonetheless, these are just two examples of the chronic diseases that are among today's greatest societal problems, and which cannot be effectively addressed by our radically unprepared health infrastructures.

Outdated models

Current healthcare models the world over are up to 50 years old, and are primarily aimed at dealing with sickness, as opposed to promoting health. These systems are largely organized around acute care: patients become ill, attend their GP for an assessment, and may be referred to a specialist for diagnosis and treatment. This approach ultimately fails to tackle health issues at source, for example, by addressing early indications of disease, despite widespread awareness of the massive impact that small changes in lifestyle (eating healthily, exercising, not smoking) could have on global disease burden.

Advances in technology offer many exciting tools with which to respond to these challenges, but must be accompanied by systematic changes in the healthcare industry that offer new incentives, roles and responsibilities to patients, medical professionals, and healthcare providers alike. Without this change in priorities, healthcare will remain in essence "sick care", and the healthcare industry will run the risk of missing the true goal of healthcare: significantly improving patient quality of life.

A broader healthcare perspective

The incidence of chronic disease, which accounts for 80% of healthcare spending, can be significantly influenced by implementing changes in behaviour, tackling socioeconomic factors, and monitoring early indicators of disease. A key component of the necessary change in healthcare is thus to move from an acute care system to a form of continuous care that promotes health and delays or mitigates the effects of chronic disease through small, daily interventions, actions, or incentives.

To achieve this, it is essential to view healthcare from a broader perspective, and not in isolation from social care. Practitioners need to understand the needs of their patients in broader context, and identify how significant improvements in health can be achieved via small, simple changes.

One way in which this can be achieved is to leverage recent technological advances, such as wearable technologies that enable continuous monitoring of patients outside the confines of the hospital. Remote monitoring and complex data analysis are not revolutionary concepts: similar models exist in other industries, but surprisingly, are yet to be effectively incorporated into the framework of healthcare. Similarly, the increase in social connectivity enabled by Web 2.0 and social software tools has yet to be effectively leveraged on a large scale to connect patients and caregivers, and to expand the patient's care team to include friends or family members: provided with the right tools, an untrained family member can monitor a chronic condition far more effectively than a medical professional whose periodic interaction with a patient provides a mere snapshot of their health.

None of these changes will be effective without parallel changes in reimbursement systems. For example, current systems reimburse care providers for treating patients with chronic pulmonary disease, but not for programs that tackle the root cause (such as, smoking cessation programs). A shift to a system that reimburses output (patient health), as opposed to input (sick patients) is thus essential.

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Another key feature of the healthcare of the future will be a move away from the current bricks and mortar-based system. While local hospitals will continue to play important roles providing clinical and emergency care, non-invasive specialist care will be provided to patients via global online hubs, which will gather and analyse patient data, and, in conjunction with continuous patient monitoring, use this information to make decisions based on the individual needs of patients.

Patient empowerment through technology

Examples of the types of technologies that will enable this change in healthcare include

- Philips Lumify, a mobile, app-based ultrasound system that allows streaming of results in real time, thus enabling sharing with cardiologists anywhere in the world.
- Wearable technologies, such as the patch, developed in collaboration with Radboud University Nijmegen Medical Center, that allows non-invasive monitoring of multiple parameters in recently discharged patients, including heart rate, breathing, and activity.
- Philips' pendant devices, which in addition to monitoring patient movement, provide patients with a means of two-way communication, allowing users to call for help if necessary, and providing them with reminders to manage their medication.

Crucially, the data continuously collected by these devices can be used to augment and optimize their functionality with increased use. Such as a device that is revolutionising the collection and analysis of blood samples, allowing patients to do so at home, and stream the data to medical professionals who can initiate appropriate action as necessary. This approach is being used to measure white blood cell counts in cancer patients to determine whether they are ready for their next chemotherapy session. The common aim of such devices is to bring the technology to the patient, and the data to the specialist, while removing the constraints of a healthcare system bound by location.

These technologies also provide a means of collecting longitudinal data, which is much more valuable than periodic measurements taken just during consultations. These and other technologies are the first steps towards a completely new model of healthcare, providing patients with the necessary tools to control their own health and progress, and ensuring that their caregivers can intervene at the right time.

Deep data

For this type of technology to be effective, the underlying algorithms used to interpret the data must be extremely accurate. The successful development of these algorithms has allowed researchers to probe increasingly deep levels of complex data. Philips Digital Pathology allows the analysis of biopsied tissue at the cell, protein, and even gene level, to produce a body of data that provides medical professionals with far more information than standard radiographic analysis, allowing them to incorporate genomic data, blood test results, and digital pathology data into their decision making process. Ultimately, this data fusion approach will be used to construct a model of the individual patient to identify their specific needs. Given that data pertaining to a single patient will likely exceed the size of current databases of entire hospitals, the rapid and continuous increase in computing and data storage capacity will be the means to this end, and will help open a new frontier in healthcare technology.

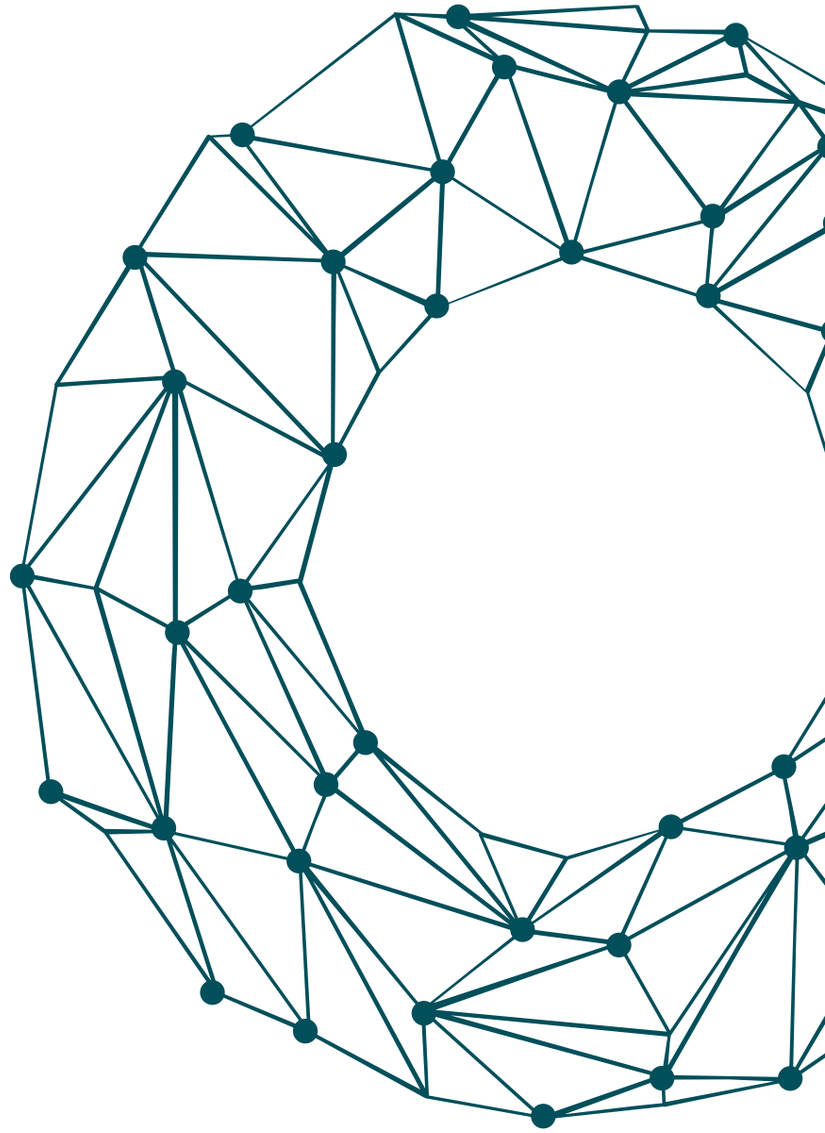
Many mundane changes will be necessary to achieve this goal. In particular, much work will be necessary to ensure that the data used is clean, standardized, and representative of the actual medical issue of interest. Data normalization represents an enormous challenge. An estimated 75% of medical data is unstructured. Accordingly, lots of basic groundwork is required to ensure that data is fit for purpose, and can be effectively aggregated, analysed, and interpreted. Facilitating greater interaction between devices will also be essential in order to provide a broader overview of the clinical situation of a given patient, allowing clinicians to address the bigger questions, as opposed to merely providing point solutions.

5

Future challenges

Given that greater patient empowerment is central to the healthcare model of the future, successful implementation of these technologies will depend on the degree to which patients are willing to use them. Thus, while the clinical aspect of these approaches is fundamental, it is equally important to understand consumer behaviour; how people use and interact with this type of technology.

However, social adoption of technology is unlikely to pose the greatest obstacle to ushering in a new era of healthcare. The greater challenges will be to ensure adoption at the regulatory level, and to institute the necessary changes in the reimbursement policies of current healthcare systems. This will be essential to usher in a new era of e-health based on network models and analytics, supported by robust, scalable utilities, to provide patients, care teams, and clinicians with a cohesive view of the patient.



6

Innovation in Healthcare: Social Responsibility of the Healthcare Insurer

Norbert Hoogers
Chairman of Zilveren Kruis

Norbert Hoogers is the chairman of Zilveren Kruis part of the Achmea Group. Before joining Zilveren Kruis he worked at KPN Telecom. He has a degree in Business Economics from Tilburg University, in the Netherlands.

Achmea is the largest insurance company in the Netherlands. Core activities include health, life and non-life insurances for consumers and businesses. Within health Achmea is the largest insurance company in Europe with a turnover of 12,8 billion euro and 5,3 million people insured in the Netherlands.

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Based on current trends, it is estimated that healthcare costs in the Netherlands will account for 40% of the country's GDP by 2040. This is due to multiple factors, including an aging population and an increased incidence of chronic disease. While the figures depict a clearly unsustainable situation, the good news is that this outcome cannot, and will not, materialize, thanks largely to innovation in the medical and healthcare sectors.

Historical precedents

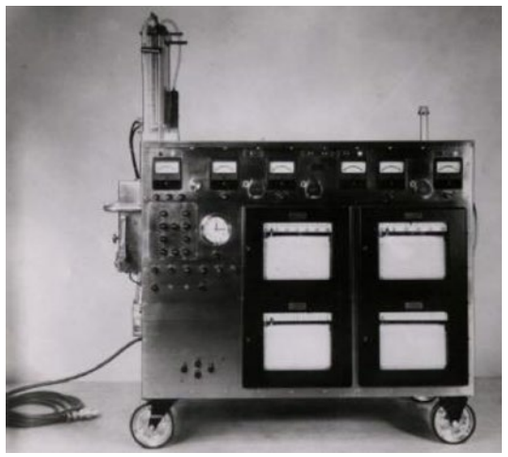
History provides us with several precedents that offer hope. In the middle ages the agricultural productivity of the Netherlands, despite needing the effort of most of the population, was clearly insufficient to feed the growing population of that era. Nonetheless, innovation in this sector has led to a situation where only 10% of the current Dutch population is dependent on agriculture for work, and the country is more than capable of feeding its citizens. Similarly, while the rapid technological advances of the industrial revolution suggested imminent redundancy of workers whose jobs would be replaced by machines, in reality this change gave rise to a massive increase in economic growth and increased demand for luxury goods, leading to the creation of a thriving services industry. These examples should be borne in mind when discussing the seemingly intractable problem of rising healthcare costs.

Jaipur Foot provides prostheses for €40 instead of €8000 and has helped over 1 million people

Necessity, the mother of... innovation?

Necessity is a key driver of innovation. Jaipur Foot is just one example of an Indian provider delivering healthcare solutions, in this case prostheses, for a fraction of the cost of equivalent services in the Netherlands. Similarly, budget cuts, an aging population, and a diminishing workforce in the Netherlands are stimulating innovation in long term care of the elderly that far surpass that seen in hospitals and primary care.

Indeed, healthcare innovation frequently comes from unexpected quarters, far from universities and major hospitals. Take John H. Gibbon's heart-lung machine, which he developed after 20 years of dogged research at Jefferson Medical College Hospital in Philadelphia.



Health insurers are interested in innovation that creates value by meeting the objectives of the Triple Aim

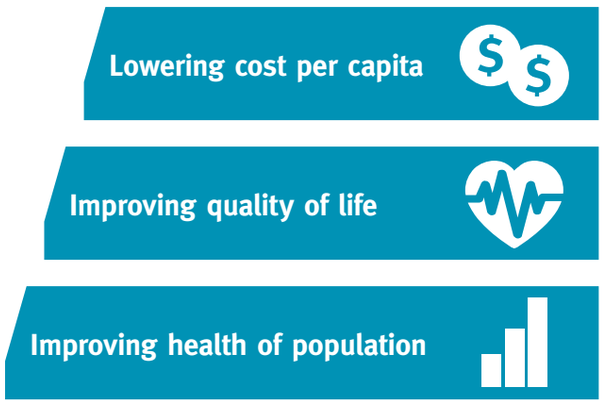
The Netherlands itself has some excellent examples of process innovation that have come from left of field, including Stichting Buurtzorg, a Dutch district nursing organization with a self-management approach, and the Dutch Surgical Colorectal Audit, which pioneered the use of transparent outcome measures in colorectal surgery.

Innovation – the role of the insurer

In the field of health insurance, innovation has traditionally focused on prolonging life expectancy and improving quality of care. However, these approaches almost always lead to increased healthcare costs. Accordingly, innovation that will ultimately help address the unsustainability of current healthcare expenditure needs to fulfil the triple aim of lowering costs per capita, enhancing patient quality of life, and improving the long term health of the population.

Health insurance providers can facilitate this type of innovation in several ways. One simple step in this direction is for insurance providers to listen to the demands of their clients (for example, the increasing numbers of well-informed patients who enquire about new treatments). Providers can also work to increase patient awareness about new technologies and the potential for self-management, for example by introducing initiatives to promote the use of wearables. Health insurers receive hundreds of project proposals every year, many of which meet the requirements of the aforementioned triple aim. While many have a solid conceptual basis, detail in terms of implementation and upscaling is often lacking, preventing adoption of the project by the insurance provider.

A more obvious target of innovation in health insurance is the procurement process, through which insurer's contract healthcare for their customers. However, innovation in this area is often met with resistance both from medical professionals and from legacy providers. Accordingly, any such proposals need to be extremely well defined, and their adoption by all the stakeholders tends to take time. An example of the successful implementation of this approach is ParkinsonNet, an online platform that connects medical professionals and Parkinson's patients. This was created by a dedicated team of medical professionals and subsequently included on a restricted basis in the procurement policy of a health insurance provider, with other providers later following suit as the success of the project became evident.



Health insurers are interested in innovation that creates value by meeting the objectives ofthe Triple Aim

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Innovation through cooperation

Cooperation between insurance providers is a third pathway to promoting innovation. Interestingly, the health insurance market in the Netherlands is relatively conducive to this type of collaboration, given that almost 90% of the population are covered by only four insurance providers. This allows for considerable innovation, particularly at the level of infrastructure investment, when providers work with one another on a non-competitive basis, as exemplified by a recent project that oversaw the creation of infrastructure to promote data exchange between healthcare providers.

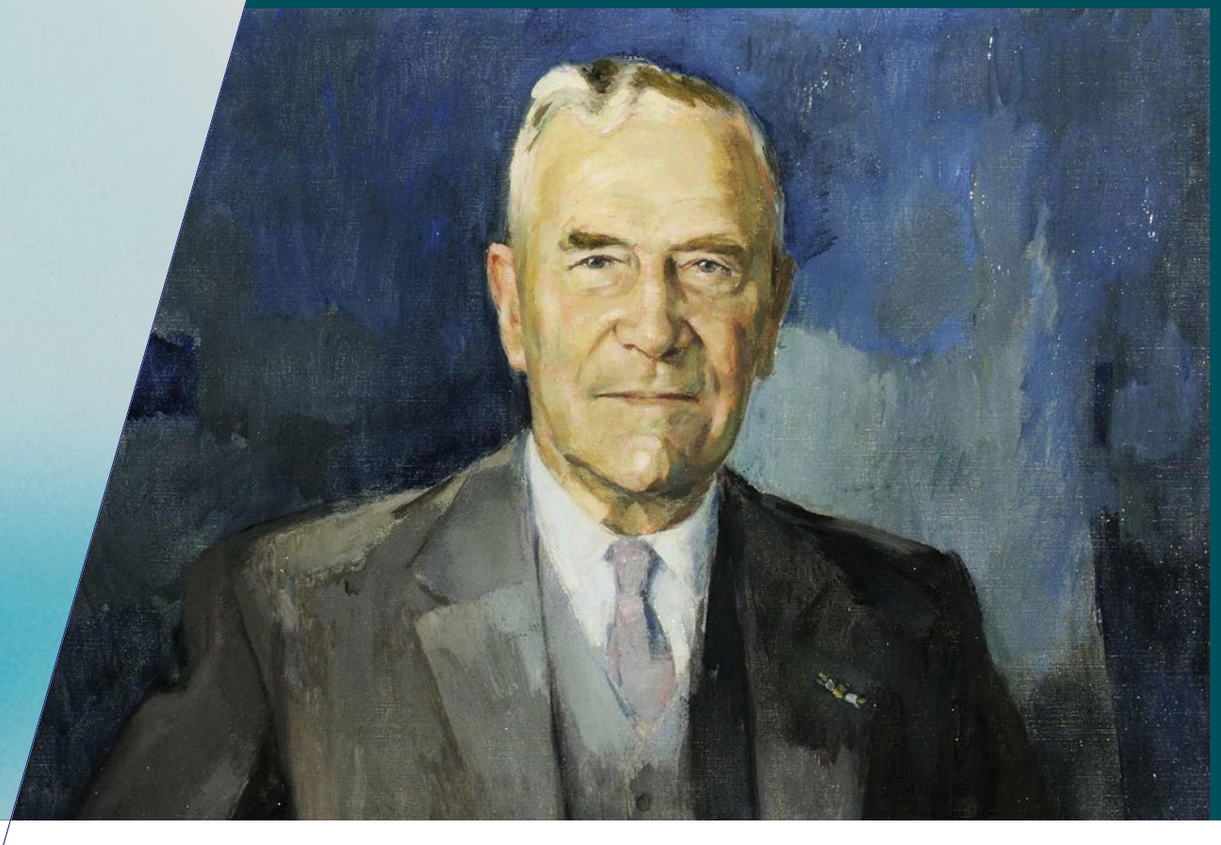
Indeed the Dutch health insurance system is probably a better environment for innovation than a fully public system. The country has a well-developed and strongly networked healthcare infrastructure, together with strictly regulated insurance companies, and the public system is in effect run by private entities, which tend to be more demanding than governmental organizations in terms of quality and productivity. This translates into a greater focus on innovation.

Moreover, the limited number of health insurance providers means that it is relatively easy for these parties to come together to standardize novel approaches, while maintaining freedom of choice for the client. While innovation at this level will always face resistance from stakeholders and existing interests, the characteristics of the Dutch healthcare system make it particularly well equipped to effectively develop and implement innovative solutions to deal with the healthcare challenges of the coming years.

7

History of the Holst Memorial Lecture and Award

The Holst Memorial Lecture is held each year at the University of Technology in Eindhoven (TU/e), the Netherlands, with support from Philips Research. The theme reflects an important contribution to the development of research and technology, in line with the idea advocated by Dr. Gilles Holst concerning the development of applied sciences, particularly mathematics and the natural sciences, for the benefit of industry on the one side and their implications for society on the other.



The Holst Lecture is given by an eminent scientist in a selected field of research. Candidates for the lecture and the associated Award are selected by a committee consisting of representatives of both Royal Philips Electronics and the University, under the chairmanship of the Rector Magnificus of the TU/e and the CEO of Philips Research.

The audience is made up of university staff and students, representatives from industry, and other guests with a general interest in science and technology. To honour the guest speaker, a symposium with invited speakers precedes the Memorial Lecture.

After the Lecture, the Rector Magnificus presents the Guest Speaker with the Holst Memorial Lecture Award, a medal designed by Dutch sculptor Jos Reniers.

Gilles Holst (1886-1968)

As an academic, Gilles Holst is best known for the essential part he played at the University of Leiden, the Netherlands, in the discovery of superconductivity by Nobel Laureate H. Kamerlingh Onnes.

However, Holst is first and foremost remembered as the founding director of the famous ‘Nat Lab’, the Philips Physics Laboratory in Eindhoven, where he worked between 1914 and 1946. Gilles Holst was also chairman of two committees that were instrumental in establishing the University of Technology in Eindhoven in 1956.

List of Holst Memorial Lecture Award Recipients

8

The first Holst Memorial Lecture was given in 1977 to commemorate the 21st anniversary of the founding of University of Technology. Since then the speakers have included:

1977 **Dr. Alexander King,** Director OECD, Paris, 'The role of the engineer and the engineering sciences in future society'.

1978 **Prof. Dr. Cristopher Freeman,** University of Sussex, Brighton, UK, 'Technology and employment: long waves in technical change and economic development'.

1979 **Prof. Dr. Carl Friedrich Von Weizsäcker,** Max Planck Institute, Starnberg, Germany, 'Langfristige Energiepolitik als Beispiel technischer Zukunftplanung'.

1980 **Prof. Kevin Lynch,** MIT, Cambridge, USA, 'What is a good city? General theory of good city form; a new try at an old subject'.

1981 **Prof. Dr. Hendrik B. Casimir,** Philips N.V., Eindhoven, the Netherlands, 'Gilles Holst, pionier van het industrieel onderzoek in Nederland'.

1982 **Dr. Michiyuki Uenohara,** Nippon Electric Co, Kawasaki, Japan, 'The Japanese social system for technological development; its merits and demerits'.

1983 **Prof. Dr. Joseph Weizenbaum,** MIT, Cambridge, USA, 'The place of the computer in our world'.

1984 **Prof. John M. Ziman,** F.R.S., Imperial College London, UK, 'Doing my own work: the individual in collectivized science'.

1985 **Prof. Ilya Prigogine,** Nobel Laureate, The Solvay Institute, Brussels, Belgium, 'Exploring complexity from the intemporal world of dynamics to the temporal world of entropy'.

1986 **Prof. Sir Hermann Bondi,** F.R.S., Churchill College, Cambridge UK, 'The application of satellites in connection with the environment'.

1987 **Prof. Dr. Dick Swaab,** Dutch Institute for Brain Research, Amsterdam, the Netherlands, 'De klok in onze hersens'.

1988 **Prof. Dr. Abraham Pais,** Rockefeller University, New York, USA, 'Einstein's influence (the impact of Einstein's relativity theory)'.

1989 **Sir John Maddox,** Nature Magazine, London, UK, 'How true is the promise of science?'.

1990 **Prof. Dr. Cornelis M. Braams,** FOM-Institute Plasma Physics, Nieuwegein, the Netherlands, 'Kernfusie in historisch perspectief'.

1991 **Prof. Dr. Philippe G. de Gennes,** Nobel Laureate, ESPCI, Paris, France, 'Bubbles, foams and other fragile objects'.

1992 **Dr. Arno A. Penzias,** Nobel Laureate, AT&T Bell Laboratories, Holmdel, USA, 'The future of knowledge intensive industries'.

1993 **Prof. Dr. Henk C. van de Hulst,** University of Leiden, the Netherlands, 'Het astronomisch spectrum'.

1994 **Prof. Dr. Donald P. Greenberg,** Cornell University, Ithaca, New York, USA, 'Imaging and the electronic age'.

1995 **Prof. Dr. Hubert Curien,** Université Pierre et Marie Curie, Paris, France, 'Big instruments and big programmes for research; where is the limit?'.

1996 **Prof. Dr. Serguei P. Kapitza,** Russian Academy of Sciences, Moscow, Russia, 'World population growth and technology'.

1997 **Prof. Dr. Nicholas Negroponte,** MIT, Cambridge, USA, 'Why Europe is so unwired'.

8

List of Holst Memorial Lecture Award Recipients

1998 **Prof. Dr. Alan J. Heeger,** Nobel Laureate, University of California, Santa Barbara, USA, '20 years of research into conducting and semiconducting polymers; is it worth the effort?'.

1999 **Prof. Dr. H. Koenraad Hemker,** University of Maastricht, the Netherlands, 'Een bloedstollende geschiedenis'.

2000 **Dr. Rod C. Alferness,** Lucent Technologies, Holmdel, USA, 'Optical networks, enabler of the communication revolution'.

2001 **Dr. John L. Hennessy,** Stanford University, Stanford, USA, 'Directions and challenges in microprocessor architecture'.

2002 **Dr. Harold G. Craighead,** Cornell University, Ithaca, USA, 'Nanostructures for mechanical and biological applications'.

2003 **Dr. Sanjiv Sam Gambhir,** Stanford University, Stanford USA, 'Imaging diseases with molecular detectives'.

2004 **Sir Richard Friend,** FRS, University of Cambridge, UK, 'Plastic Electronics: new science, new technology, new products and new markets'

2005 **Dr. J. Craig Venter,** the Venter Institute, Rockville MD USA, 'From the Human Genome to Environmental Metagenomics'

2006 **Prof. Dr. Peter Carmeliet,** KU Leuven en VIB, Belgium, 'The neurovascular link of A. Vesalius revisited'

2007 **Prof. Dr. Henk van der Vorst,** RU Utrecht, the Netherlands, 'Men and Computers: an Upward Spiral'

2008 **Prof. Dr. Shuji Nakamura,** University of California Santa Barbara USA, 'Current and Future Status of Sold State Lighting'

2009 **Prof. Dr. Rutger A. van Santen,** Royal Academy of Arts and Sciences professor at TU/e, 'Energy, Catalysis and Society'

2010 **Dr. Denis Le Bihan,** Neurospin, Gif-Sur-Yvette, France 'Water: from Brownian Motion to the Mind'

2011 **Prof. Donald E. Ingber MD, PhD,** The Wyss Institute, Harvard University, USA. 'From Cellular Mechotransduction to Biologically Inspired Engineering'

2012 **Russel Foster, Bsc, PhD,** FRS, The Nuffield Laboratory of Ophtalmology, Oxford University, UK, "Light and the Rhythm of Life'

2013 **Cherry A. Murray, PhD,** Dean Harvard School of Engineering and Applied Sciences, 'Engineering for All'

2014 **Dr. ir. Robert Cailliau,** Former staff member CERN, 'The Web Adventure'

2015 **Prof. dr. Bastiaan R. Bloem, MD, PhD,** Radboud University Medical Center, Nijmegen, the Netherlands 'Healthcare Networks need Innovative Technology'

Imprint

Holst Committee

Candidates for the Holst Memorial Lecture 2015 were selected by the Holst Committee under the joint chairmanship of
Frank Baaijens, Rector Magnificus Technische Universiteit Eindhoven (TU/e) and Henk van Houten, General Manager Philips Research.
Secretary to the Committee: Joep Huiskamp (TU/e).

Members of the Scientific Organizing Committee 2015

Franklin Schuling (Philips Research),
Jörg Habetha (Philips Research),
Jan Bergmans (TU/e).
Secretary to the Committee: Joep Huiskamp (TU/e).

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On the 26th of November, 2015, Eindhoven University of Technology hosted the Holst Memorial Lecture and Symposium, with the support from Philips Research. This cooperation is fitting for an event commemorating Gilles Holst. He both founded the Philips Physics Laboratory in Eindhoven, which later became Philips Research, and was instrumental in founding the Eindhoven University of Technology.

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