



# SensUs 2018

Program

# Content

Program.....	3
Welcome.....	4
SensUs Organization.....	5
What is SensUs?.....	6
Participating Universities	7
Theme & Biomarker.....	8
SensUs Teams.....	10
Speakers.....	17
Awards & Jury process....	18
Jury Members.....	19
Partners.....	20
SensUs Interviews.....	22
Personal Story.....	26
Closing.....	30

# Program

## **Friday 7th of September 2018**

- 13:00 - 13:30 Opening SensUs 2018
- 13:15 - 17:00 Market
- 13:40 - 15:40 Testing event
- 15:50 - 17:35 Technical pitches
- 15:50 - 17:35 Translation potential pitches
- 17:15 - 18:15 Closing and network drink

## **Saturday 8th of September 2018**

- 13:00 - 13:30 Introduction pitches teams
- 13:30 - 15:15 Market
- 13:40 - 14:45 Team pitches
- 15:00 - 15:45 Shawna Butler - Precision, speed, and privacy – How does technology get us closer?
- 15:45 - 16:45 Award ceremony
- 16:45 - 18:00 Network drink

# Welcome to SensUs 2018



## **Prof. dr. Menno Prins**

Founder of SensUs

Welcome visitors and participants of SensUs 2018! We are going to admire 13 student teams from universities in North America, Asia, Africa, and Europe, that have developed biosensors for the measurement of antibiotic drugs in blood. The teams will present their biosensors and creative ideas on innovations in healthcare. In SensUs the students learn how to be courageous, develop a vision, work together, and make real prototypes. Also university professors, companies,

healthcare professionals, and patients play their parts. SensUs brings us all together in order to innovate and learn about innovation. Thank you for being here and I wish you two lively and inspiring SensUs days.



## **Eliene Rutten**

Chair of SensUs

Welcome to SensUs 2018, the third edition of the SensUs student competition! SensUs is organized for students by students. We are completely free in how to organize this novel international student competition. Being part of the SensUs organization is an unforgettable experience in which we aim to organize a smashing contest weekend. I am very excited and proud of the success that SensUs has become, and I am thrilled for the future.

Dear visitors and participants, together we will admire the amazing achievements of the student teams. On behalf of the SensUs organization I wish you a very inspiring SensUs event.

# Sensus Organization



## Chairs & Co

Bart Engelen  
Eliene Rutten  
Marliek Raadsheer  
Henriëtte Eijking

From left to right and from top to bottom.



## Media

Luuk Kemna  
Kirsten Peeters  
Ido Golan  
Rutger van Doorslaer  
Maritza Rovers

From left to right.



## External Relations

Abel Goedegebuure  
Roderick Haarselhorst  
Quirine Verbeek

From left to right.



## Technology

Hanna Merényi  
Maaïke Konig  
Aaron Saam  
Yi He Zhu

From left to right.



## Events

Hannah Brouwer  
Irma Vermeijlen  
Maria Pop

From left to right.

# What is SensUs?

## The future of healthcare

An important aim in healthcare is to keep people healthy as long as possible and to enable people in need of care to live a high-quality life in their own environments. Healthcare is developing toward a world wherein care is delivered in a highly personalized manner, attuned to the status of the patient, based on actual, precise and reliable data. This is where biosensors play a big role.

## Our mission

The mission of SensUs is to stimulate the development of biosensors in a friendly competitive manner whereby students design and make innovative biosensors. Each year a different healthcare theme is selected. The focus of SensUs 2018 is on antibiotics.

## The teams

The participating teams consist of students from multiple scientific disciplines. Biosensing technologies are inherently multidisciplinary. To be successful, the teams need to creatively combine molecular technologies and device technologies. The style of the competition is 'friendly competitive'. Teams of students compete for different prizes. However, it is equally important that teams learn from each other, share information, and sow seeds for international collaboration.

## A platform for collaboration

SensUs stimulates information sharing and community development for continuous innovation in biosensors. It forms a platform for open innovation and welcomes stakeholders such as healthcare organizations, patient organizations, R&D funding organizations, and companies to give input or otherwise partner with the competition.

# Participating Universities

Imperial College  
London



NC STATE UNIVERSITY



Université  
de Montréal



RWTHAACHEN  
UNIVERSITY



UVIC  
UNIVERSITAT DE VIC  
UNIVERSITAT CENTRAL  
DE CATALUNYA



## Measuring antibiotics for better healthcare

SensUs 2018 challenges student teams to develop innovative biosensing systems for the measurement of the antibiotic drug vancomycin. Antibiotics have transformed medicine and saved millions of lives. Unfortunately, the massive use of drugs causes Anti-Microbial Resistance (AMR). Drug-resistant bacteria are appearing and this calls for more precise treatments, including optimal dosing of the drugs. Biosensors can rapidly and easily give feedback to patients and doctors. A vancomycin biosensor will help to provide patients always with the right dose, in order to increase the effectiveness and avoid side effects of drug treatment.

## What is an antibiotic?

Antibiotics are pharmaceutical drugs that help stop bacterial infections. The drugs either kill the bacteria or inhibit their reproduction. Antibiotics actually means “anti-life”, in other words, every drug that kills bacteria is an antibiotic. The first drug to carry the name antibiotic was Penicillin, discovered in 1928 by Alexander Fleming. Bacterial infections can occur everywhere in the body, for example in the skin, in wounds, and inside organs. However, antibiotics must be used with caution, as overuse is a growing problem which has caused bacteria to become resistant against antibiotics. Bacteria can mutate and thereby generate strains that become more and more resistant to the antibiotic drug.

## Vancomycin

The biomarker of this year is vancomycin, which is one of the last-resort antibiotics. It is effective against Gram-positive bacteria such as Methicillin-resistant *Staphylococcus aureus* (MRSA), which can cause very severe and sometimes fatal infections. Vancomycin fights the Gram-positive infections by making the cell-wall unstable and impeding its synthesis, causing the bacteria to die.

# Together for healthy lives in Europe



EIT Health is proud to support SensUs through its education pillar, EIT Health Campus.

EIT Health is a network of best-in-class health innovators backed by the EU. By collaborating across borders, we deliver solutions to enable European citizens to live longer, healthier lives.

As Europeans tackle the challenge of increasing chronic diseases and multi-morbidity, and seek to realise the opportunities that technology and digitalisation offer to move beyond conventional approaches to treatment, prevention, and healthy lifestyles, we need thought leaders, innovators and efficient ways to bring innovative healthcare solutions to market.

EIT Health addresses these needs. We connect all relevant healthcare players across European borders – making sure to include all sides of the “knowledge triangle”, so that innovation can happen at the intersection of research, education, and business. We bring together healthcare professionals, entrepreneurs, and citizens, offering them new opportunities and resources.

We give health innovators access to the market, to funding, and to the expertise of our network. We facilitate innovation in programmes, workshops, and initiatives. We collaborate on international projects – and disseminate our findings in the media, events, and publications. We create new products and services for healthy lives in Europe. And we educate, too: in citizen engagement activities, innovation programmes, and skill development trainings.

Learn more at [www.eithealth.eu](http://www.eithealth.eu)

# SensUs Teams



**VanGow**  
University of Glasgow



**AIXSense**  
RWTH Aachen



**SenseNC**  
NC State University

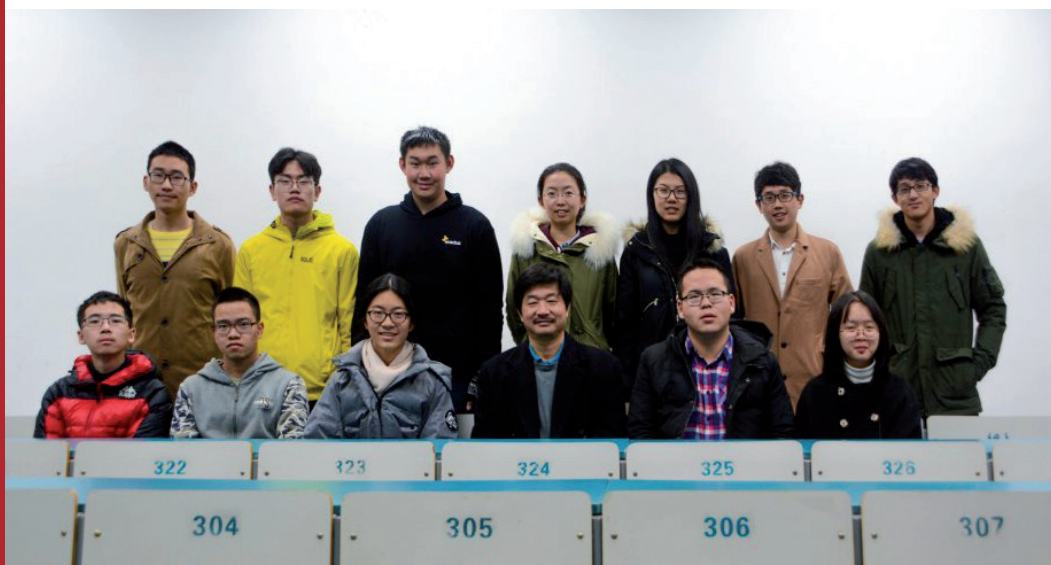


**The American University in Cairo**

# SensUs Teams



**SensImperial**  
Imperial College London



**TruSense**  
Zhejiang University



## **SenSwiss**

École Polytechnique Fédérale de Lausanne



## **T.E.S.T.**

Eindhoven University of Technology



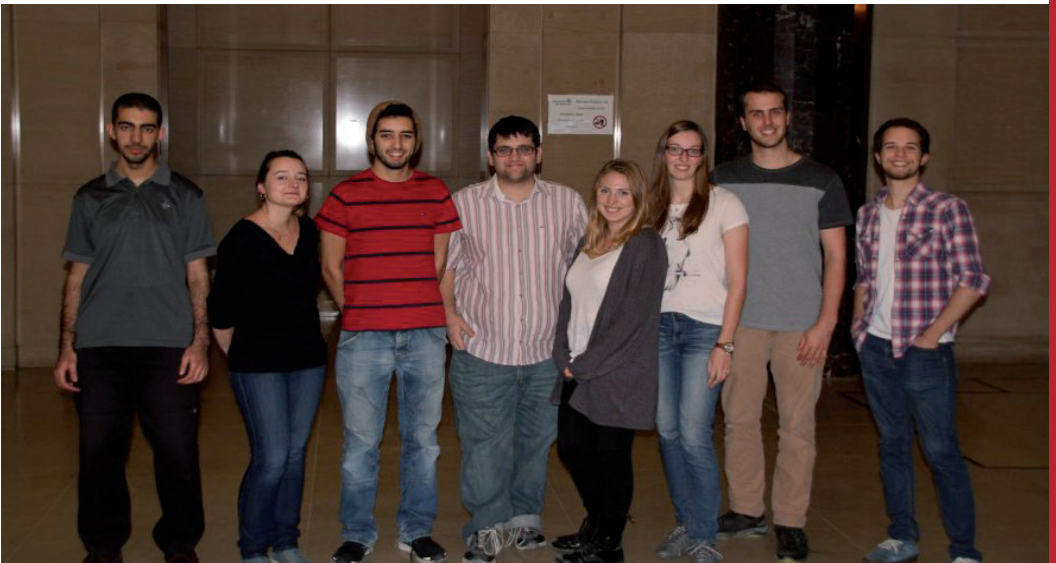
**UScience Tech Barcelona**  
BarcelonaTech and University of Vic



**VancoSense**  
KU Leuven



**U.V.S**  
Uppsala University



**BiosensUM**  
Université de Montréal



## **DetectUs** Technical University of Denmark



## Master of Ceremonies Amy Yewdall

I am a Kiwi postdoctoral researcher in Jan van Hest's group at the TU/e, predominantly focused on creating an artificial cell, or at least mimicking the properties of life in synthetic systems. Science communication is something I've always been passionate about! I think it is important that the wider community understands what is going on in the lab, as their needs can direct our research. I look forward to helping out as MC on the big SensUs day!

## Keynote Speaker Shawna Butler

As the EntrepreNURSE in Residence at REshape Innovation Center at Radboud University Medical Center and part of the Exponential Medicine team at Singularity University, I bring the clinical, practical, and human sensibilities of a nurse to work with early-stage ventures, large-scale enterprises, and emerging and converging technologies. I listen, learn, find, and activate the mavericks and projects with a serious chance of delivering better health outcomes and making society stronger.



## Awards

The **Analytical Performance award** goes to the team with the biosensor that functions best, in terms of measurement accuracy, speed, and required sample volume.

The **Creativity award** relates to the technological novelty of the biosensors and to the way how the teams have worked during their development process.

The **Translation Potential award** is about the plans of the teams to bring their bio-sensor from a prototype to a product that can be used in society. Will the product meet the needs of doctors and patients, and will it be suited for industrial production?

The **Public Inspiration award** gives recognition to the teams that best inspire the public. The award is based on the votes from the public, who see the presentations, pitches and demonstrations of the teams.

## Jury Process

The Analytical Performance award and Public Inspiration award are based on numerical output. The Creativity award and Translation Potential award are based on judgments by members of the jury. The jury consists of people from universities, companies, healthcare, and innovation organizations.

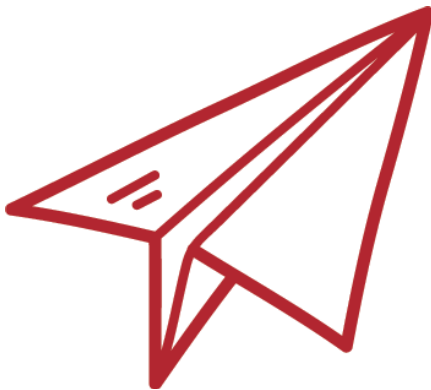
## Creativity award

Kees Verduin  
Tony Cass  
Julien Reboud  
Philippe Renaud  
Michael Daniele  
Masood Kamali-Moghaddam  
Jeroen Lammertyn  
Jasmina Casals-Terré  
Liquan Huang  
Hassan Azzazy  
Leo van IJzendoorn  
Winnie Svendsen



## Translation potential

Rogier Hopstaken  
Arjan van Drongelen  
Stephan Hulsbergen  
Marko Blom  
Alexander van Reenen  
Menno Kok  
Roger Brüggemann  
Ashley de Bie  
Annelies Bobelyn  
Isabelle Reymen  
Jean-François Masson  
Hugo Ferreira





**ASML**

**Medtronic**

Further, Together



Partner in zorginnovatie



HIGH TECH  
CAMPUS  
EINDHOVEN



TU/e Honors  
Academy



**AXXICON**

scienion  
ENABLING LIFE SCIENCE





***We spoke with Kees Verduin, a medical microbiologist who currently works at PAMM. He told us why we need to be concerned about the problem of antibiotic resistance.***

***Q. Does the widespread use of antibiotics affect your work as a medical-microbiologist?***

**A.** Since antibiotics work very effectively in most cases, doctors tend to prescribe them often, many times even too often. You see this happening in many healthcare settings all over the world. However, there are big differences in usage of antibiotics: In some countries the use is very high while in others, for example in the Netherlands, the use is much lower. What one forgets is that many infections will heal without antibiotic therapy, yet we often prescribe antibiotics just to be sure or to reassure the doctor and the patient. A common thought is that as long as we use antibiotics to fight infections, we will be able to cure everybody. Unfortunately, that is not true. If we continue to prescribe too much antibiotics, we will have no cure for many serious infections in 30-40 years due to antibiotic resistance. So, my job as a medical-microbiologist gets harder with the day, because millions of people use antibiotics around the world and resistance is rising rapidly. For this reason we need to find new ways to fight infections, in a world where antibiotics are becoming almost useless in many cases.

**Q. Regarding the general problem of antibiotic resistance, what is in your opinion the main challenge and what is necessary in order to tackle it?**

**A.** Antibiotic resistance is a big problem in the Netherlands, however it is not so bad in comparison with other countries in Europe or in the rest of the world. Together with Scandinavia, the Netherlands is one of the countries with the least deaths per year due to antibiotic resistance. Some people think that the biggest challenge is to convince big pharmaceutical companies to develop new antibiotics, however, I am afraid that there are things that money cannot buy. When looking at drug development, the most effective antibiotics that we use nowadays were discovered over 40 years ago. Unfortunately, it seems that we cannot successfully continue antibiotic development. I am an optimistic person, however I am afraid that humans might never find new revolutionary antimicrobial drugs ever again. So, antibiotic resistance is a big problem, and there is no remedy in sight at this moment.

As I stated before, antibiotic resistance is a huge problem worldwide. When looking at the numbers, we see that there are rising numbers of death due to antimicrobial resistance. Although this is still rare in the Netherlands, the situation in other countries is much worse. Greece and Italy have very serious problems with patients that can no longer be effectively treated with antibiotics.

**Q. The theme of SensUs 2018 is “Measuring antibiotics for better healthcare”. What is its relevance to society?**

**A.** When giving an antibiotic one wants to be sure that the dose is right and the concentrations in the blood are high enough to be effective. In addition, some antibiotics are toxic and measuring concentrations in the blood can prevent serious complications, such as kidney failure or liver toxicity. Therefore, measuring antibiotic concentrations in blood is very important. Nowadays measuring concentrations is difficult and takes a long time, making it less useful for optimization of treatment.

# SensUs Interview: Menno Prins



***To get an insight in the man behind our mission we interviewed professor Prins - the founder of the international student competition SensUs.***

***Q. Who are you and what are your daily activities on the TU/e? What is your history with biosensors?***

**A.** I am a professor at Eindhoven University of Technology working in the field of biosensors. Before that, I worked for many years in industry. I am fascinated by new technologies for biochemical sensing and applications in the fields of near-patient testing and patient monitoring. So my thoughts go to fundamental questions as well as to applications and translation to society. SensUs has good synergy with all these aspects, as it stimulates education as well as innovation and entrepreneurship.

My main responsibilities are to train and inspire young scientists. Students need to acquire basic knowledge as well as learn how to become creative with this knowledge. For creativity they need to learn how to think independently and dare to walk new paths. Research is one way to learn such skills, and SensUs is another. Particularly demanding in SensUs is the need to work together as a team and be as effective as possible in reaching a goal. This is what I learned myself when working in the industry, and what I hope that all students learn when they participate in SensUs.

**Q. Why is this year's theme 'Measuring antibiotics for better healthcare'?**

**A.** Antibiotics are anti-microbial drugs that have transformed medicine and saved millions of lives. However, due to wide-spread use of the drugs, bacteria are appearing that are less and less sensitive to the available drugs, a problem called Anti-Microbial Resistance (AMR). Therefore antibiotic treatments should change and should be given in a much more precise way: patients should receive the right drugs at the right dose at the right time for the right duration. This is where biosensors can help, because they will give accurate and timely data on drug concentrations in the patient. Based on this data the treatment of the patient can be adapted and will be as effective as possible, with minimal appearance of resistant bacteria.

**Q. What are the technological difficulties in designing a biosensor for an antibiotic? Why don't we have such a biosensor already?**

**A.** Molecules that are essential for the body, such as proteins, hormones, and drugs, are present in the blood in low concentrations, typically between micromolar down to picomolar concentrations. Such measurements are normally done in a laboratory using large instruments, where blood samples are processed through an elaborate process with multiple steps and biochemical reagents. A biosensor is very different, because the test should be rapid and the device should be small. This demands novel technological approaches in biochemistry, fluid handling, and detection, without compromising on the accuracy of the final measurement result. In addition to the technological challenges, also economical challenges play a role. The development of a new medical product requires a considerable financial investment, which is made only if there is an attractive business model with clear medical added value and a cost-effective technological solution.

**Q. How does SensUs contribute in these developments?**

**A.** SensUs trains students in multidisciplinary technological development and entrepreneurship, and SensUs brings together stakeholders such as university professors, medical professionals, and companies. This generates new ideas and new solutions, some of which will help to close the gaps between technology, medical application and business.

# Personal Story: Gerard van Bokhorst



***For SensUs Personal Stories, we spoke with Gerard and Anja van Bokhorst about their experiences with Gerard's treatment with vancomycin, and about the importance of developing biosensors for this last-resort antibiotic drug.***

My name is Gerard, I am 59 years old and happily married to my wife Anja. Together we have a family with four children. Unfortunately, I cannot say that I am born healthy, but at least I was born with an angel watching over me.

I was born with polycystic kidney disease. This is a heritable disease that replaces the kidney tissue with cysts. I started dialysis in 2006, but soon I realised that this is a very uncomfortable and time-consuming occupation. I had to go to the hospital three times a week to dialyse four hours, therefore I decided to start dialysing myself at home. I had to do some training to handle the machine but after that, I was able to dialyse independently at home, with the help of my wife. Now, I do this six times a week for 2.5 hours. I am not dependent anymore and it takes less time, as it is not necessary to travel for treatment. This ensures that I have time to enjoy my hobbies: spending time with my wife, playing with my grandchildren and motorcrossing. After dialysis I feel so much better!

Currently I do not have any kidneys. I once had a kidney transplantation, but unfortunately my body rejected the kidney. I am still on the waiting list for another transplantation, but before that my body has to be in a good condition, which is not obvious for me.

The annoying part of being ill is not feeling ill, but accepting it. I have faced a lot of infections and other inconveniences, some of them were really critical, but I always managed to recover. Except when I got a Clostridium infection: I was damaged by that what was supposed to save me.

In November 2017 I got a bacterial Clostridium infection. I had to be treated with the antibiotic drug called vancomycin, which was dosed three times a day over three weeks. The dose was determined by a standard protocol, based on information such as body weight, length and age. However, I always joke that I am a special case since I do not have any kidneys and perform dialysis. This means that drugs have a stronger effect on me than on normal patients, because the drug is removed less efficiently from my body.

Nevertheless, everything went well and we thought I was cured of the infection. Later on, I got pain in my neck and shoulders. The pain was so bad that I was treated with morphine to reduce it. The other day I was hospitalized. All kind of medicines against fungi and prednisone were administered, since I once had a fungal infection called Aspergillus. This was all for prevention because the doctors thought that the Aspergillus might have come back. It was not possible for me to undergo an MRI scan because I had an Implantable Cardioverter Defibrillator (ICD). This is a little device in the heart that gives a shock to recover the heart rhythm if necessary. The doctors did not know what was going on. What was happening inside my body?

Yet another scan showed that there were spots visible in my neck, groin and heart. The ECG confirmed the suspicion; I again had a bacterial infection. The ICD had to be removed because of the infection. This was a risky operation since all the wires of the ICD were infected and already fixed in my veins. I had become a walking bacterial bomb. After this operation I was treated with vancomycin for six more weeks, however, this time with a much higher dose. I got really sick from this treatment. The pain in my neck and shoulders was so awful that I needed morphine. The dose was injected in 2 hours, but this was way too fast for me. I blanked out, had dyspnea and breathing problems, itching of the skin, and fever. My wife called the nurse and explained that the drug delivery should be delayed. After a long discussion and perseverance they finally tried it, and it was a real improvement.

***(continues on next page)***

In total I spent nine weeks in the hospital during my treatment with vancomycin. In the first three weeks during my first infection, my dosage was slowly increased, controlled by taking blood during my dialysis. In the period of my second infection, I was not able to eat due to overall malaise. By the time I got home I could finally eat again. This is why I think that being treated at home is so important. One feels so much more comfortable in one's own environment. But, the damage was already done.

The treatment with vancomycin had really damaged me and I am still emaciated. My limbs are fluffy, I lost a lot of weight, and I still have no energy. I was not able to eat and my body did not get any nutrients. When I was home, I started working out again, to gain energy and feel better. However, I have the idea that this all could have been prevented by a better treatment, namely by personal dosing of the vancomycin. I am a really special case because of missing my kidneys, but nevertheless the doctors applied the same therapy for me as for normal patients, which I apparently could not handle. A better understanding of me as individual would have helped me a lot. This is why I think that personal dosing is very important.

I think that a biosensor for drugs such as vancomycin, which can enable personal dosing, could really aid treatment. Levels of vancomycin can be monitored and adjusted in a much more controlled way, opposed to the guesswork used now. My blood was taken, and only after 24 hours we knew the results. Then it was concluded that my level was way too high, but in the meantime I already received another dose. It would have been better if my dosage was instead adjusted to my personal needs. Not only can a biosensor help with dosing the right amount of medication, but it can also be useful in the quality of the treatment by enabling home monitoring, preventing hospitalization and all kinds of inconveniences.

I really think that SensUs can have a big impact on healthcare. Very often you see that people want to take control of their own lives. People who are chronically ill would like to be more involved and want to map out their treatment. In that way, patients are also more aware of their conditions and the usefulness of the medication they have to take. I think that biosensors can be a breakthrough, improving the well-being of patients. It definitely would have helped to make my treatment safer, more effective, and more comfortable.

IN THE TIME  
IT TOOK  
YOU TO  
READ THIS  
SENTENCE  
**SIX MORE  
LIVES WERE  
IMPROVED**



Each year, Medtronic helps alleviate pain, restore health and extend lives for millions of people around the world. In fact, two people every second are positively impacted by our breadth of medical technologies and therapies.

**Because every second counts.**

Learn more at **medtronic.com** and search for "the promise of biosensor technology".

# Closing

The SensUs organization would like to thank you for visiting this event. We hope you had an inspiring and innovative time and enjoyed the creations of our teams. The universities participating in SensUs 2019 are:

	Germany RWTH Aachen		Portugal University of Lisbon
	Scotland University of Glasgow		The Netherlands Eindhoven University of Technology
	United States NC State University		Belgium KU Leuven
	Egypt The American University in Cairo		Denmark Technical University of Denmark
	England Imperial College London		Canada Université de Montréal
	China Zhejiang University		Sweden Uppsala University
	Switzerland École polytechnique fédérale de Lausanne		Spain BarcelonaTech and University of Vic

# ASML

## Sponsor of Sensus

[www.sensus.org](http://www.sensus.org)

To foster entrepreneurship in the region, ASML is one of the founding members of the Eindhoven Startup alliance, who's ambition is to create at least 100 high-tech companies by 2020. The vehicle that the alliance has chosen to achieve its mission is HighTechXL - a framework of programs designs to drive innovation teams from ideation to scaling up.

**HIGH  
TECH** **XL**

Eindhoven Startup Alliance:



**ASML**



**HIGH TECH  
CAMPUS  
EINDHOVEN**





# Sensus

The international competition on biosensors for health