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**PRESS RELEASE**

**Mini human organs for drug testing and personalised medicine: Hans Clevers is finalist for European Inventor Award 2017**

* **Dutch molecular geneticist nominated for EPO prize for invention of "organoids"**
* **Lab-grown mini organs allow safe testing of treatments outside the body**
* **Mini versions of human intestines, livers, kidneys and other organs are now used in drug development, cancer research and personalised medicine**
* **Patented invention offers viable alternative to animal testing in drug research, and cuts time to market for new medicines**
* **EPO President Battistelli: "Clevers’ invention offers a safer and more sustainable basis for medical testing and drug development.”**

**Munich, 26 April 2017 –** Pharmaceutical development is a long and costly process, requiring years of research and millions of euros. Testing new drugs comprises a major part of the bill, with clinical trials adding costs and potentially putting patients at risk. But what if scientists could grow miniature replicas of human organs in the laboratory – and use them to "test drive" new pharmaceuticals? Or use them to find the optimal drug and dosage for individual patients? Thanks to Dutch molecular geneticist Hans Clevers (60) and his invention of “organoids”, this seemingly far-off possibility has become a reality.

For this achievement, Clevers has been nominated for the European Inventor Award 2017 as one of three finalists in the category "Research". The winners of the 12th edition of the European Patent Office (EPO)’s annual innovation prize will be announced at a ceremony in Venice on 15 June.

“The prospect of creating 'mini-organs' for safe medical testing has become a scientific reality thanks to Hans Clevers,” said EPO President Benoît Battistelli, announcing the European Inventor Award 2017 finalists. “His invention not only offers a safer and more sustainable basis for medical testing and drug development. It also unlocks a personalised medicine approach to treatment, enabling health care providers to gauge the effects of drugs on individual patients.”

**Challenging conventional wisdom**

Clevers was the world's first scientist to develop “intestinoids” for testing drugs on active human intestinal tissue. He achieved his breakthrough in the early 2000s while investigating intestinal cancers as Director of the Hubrecht Institute for Stem Cell Research in Utrecht. At the heart of the invention is a class of intestinal stem cells known as LGR5 stem cells, which Clevers and his team discovered. But he still faced a significant hurdle: "The dogma was that adult stem cells don't divide and multiply outside the body in a dish. Everybody knew that it was impossible, and so no one addressed this question," says Clevers. Working for over eight years and filing more than 15 patents in the process, the scientist not only successfully grew stem cells in a dish: By surrounding them in a bio-gel that provides nutrition and structural support, Clevers grew gut stem cells into "intestinoids" – miniature intestines a few millimetres in size. Developed in 2009, the process unlocked a door to unheard-of new possibilities. "We found that we could do the same thing for other organs, not only for the gut, but for the liver, lung and prostate. There is an ever-growing list now of organs that we can grow outside the human body."

**Safer and more personal medicine**

The invention of organoids solves an age-old problem in direct patient care. The effects of new medicines are tested on broad populations – not individuals – while each patient responds differently. What works for one patient might not work for another. At worst, medicines can provoke adverse reactions in the patients taking them. It is estimated that 5% of all hospital admissions in the EU are due to an adverse drug reaction, and they are the fifth most common cause of hospital death. This is where organoids can make a difference by safely pretesting drug effects – even aggressive courses of treatment (for example against cancer) – *in vitro* (outside the body).

Clevers says: "We take stem cells from the patient and grow a mini-organ from them. Then we test different drugs on the organoid. We see which drug is successful and which one is not. It is a step towards personalised medicine." Indeed, organoids hold the key to future treatments centered on an individual patient's unique genetic make-up. They can also grow "tumouroids", miniature replicas of cancerous tumours, and test the effects of potential therapies in a safe environment.

**Tiny organs, great impact**

Organoids have the potential to significantly lower costs and failure rates in drug development. Currently, only one out of every 10 000 chemicals complete the discovery cycle to emerge as an approved pharmaceutical. Late-stage clinical trial failures – presently at 50% in Phase III – are also rising. Because costs for trials range in the millions of euros, organoids can potentially decrease costs on the individual patient level, while increasing safety.

From an ethical perspective, too, Clevers' patented invention yields significant benefits: Organoids offer an alternative to the widespread use of animals for testing new pharmaceuticals. This applies especially to animal experiments that measure toxicity by determining the lethal dosage of a chemical component that is necessary to kill half of a sample population of test animals.

In terms of economic potential, analysts regard organoids as potential game-changers in the world market for three-dimensional cell cultures, a segment currently worth around EUR 561 million per year. According to analysts this number could increase to over EUR 2 billion by 2019, driven by wider availability and application of organoids.

**A physician and laboratory scientist**

Hans Clevers is regarded as an international authority in the field of miniature organs, a field he created. His key to success lies in a rare combination: Clevers is both physician and laboratory scientist. He received his PhD in Immunology from Utrecht University in 1985, and simultaneously studied medicine there, receiving an MD in 1984. Inspired by the vast potential of genetics in medicine during his postdoctoral research at the Dana-Farber Cancer Institute at Harvard University between 1986 and 1989, Clevers established his own laboratory for genetic research at Utrecht University. He is now Professor there and has been serving as Research Director of the Princess Máxima Center for Pediatric Oncology since 2015, still avidly looking for ways to impact clinical outcomes with research insights. An author of over 540 publications, Clevers has also co-founded two successful spin-off companies to bring his patented inventions to market.

While his contributions are only beginning to change clinical practice and research, they have already won Clevers numerous awards, including the Louis Jeantet Prize (2004), the Heineken Prize for Medicine (2012) and the Breakthrough Prize in Life Sciences (2013).

Currently, Clevers is looking for cystic fibrosis patients in the Netherlands to participate in an intestinoid-based therapy programme while actively pursuing another "impossible" target: Growing full-sized human organs outside the body as bioengineered "spare parts", a task for which he has already begun a stem cell specimen archive at Utrecht. "If you ask very deep questions and find answers, they will be unexpected and lead to very disruptive innovations," says Clevers.

**Additional resources**

[**Video and photo material**](http://www.epo.org/news-issues/press/european-inventor-award/2017/clevers.html)

[**Read more about the inventor**](http://www.epo.org/learning-events/european-inventor/finalists/2017/clevers.html)

**View the patents:** [**EP0972037**](https://worldwide.espacenet.com/publicationDetails/biblio?CC=EP&NR=0972037B1&KC=B1&FT=D&ND=4&date=20060816&DB=EPODOC&locale=en_EP)[**EP2795322**](https://worldwide.espacenet.com/publicationDetails/biblio?CC=EP&NR=2795322B1&KC=B1&FT=D&ND=4&date=20151209&DB=EPODOC&locale=en_EP)[**EP2393917**](https://worldwide.espacenet.com/publicationDetails/biblio?CC=EP&NR=2393917B1&KC=B1&FT=D&ND=4&date=20160406&DB=EPODOC&locale=en_EP)

**The future of laboratory-grown organs**

In a not-so-distant future, genetically-matched donor organs could be grown outside the human body and kept ready whenever the need for a transplant arises. Asked about the prospects of healing humans with laboratory-grown intestines, livers and kidneys, the inventor is optimistic: Clevers and team have already "patched up" cancerous intestines in mice with lab-grown, healthy cells and he hopes that transplanting organoids will become reality in the next five years. [**Read the full story about the future of personalised medicine.**](http://www.epo.org/news-issues/technology/medical-technologies/personalised-medicine2.html)

[**About the European Inventor Award**](http://www.epo.org/learning-events/european-inventor.html)

[**About the European Patent Office (EPO)**](http://www.epo.org/news-issues/press/background/epo.html)

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