

## REGENERATIVE MEDICINE FOR KIDNEY PATIENTS

**Professor Marianne Verhaar is a leading internist specializing in kidney disease. She heads the Nephrology Department at UMC Utrecht, led the UMCU's strategic program Regenerative Medicine & Stem Cells for over a decade and was appointed the first Clinical Faculty Professor at UMC Utrecht. She is also one of the leaders of the RegMed XB Kidney Moonshot. In this interview, she shares her insights into the power of collaboration on the path toward developing a custom-made kidney for patients with kidney failure.**

### KIDNEY PATIENTS NEED A NEW SOLUTION

More than 1.7 million people in the Netherlands have some degree of kidney damage. When that damage becomes severe, symptoms develop, and renal replacement therapy eventually becomes necessary.

The preferred treatment is a kidney transplant - but not everyone qualifies, and there is a waiting list. As a result, many patients with kidney failure are (temporarily) dependent on dialysis. Dialysis filters the patient's blood to remove waste and restore fluid and salt balance.

While dialysis is a life-saving technique, it's far from ideal. "Dialysis still leaves many waste products in the blood," explains Marianne. "The best solution is to restore the natural function through regenerative medicine."



### REGMED XB KIDNEY MOONSHOT: TOGETHER TOWARDS A CUSTOM-MADE KIDNEY

Collaboration is crucial for achieving breakthroughs in regenerative medicine. Within this Kidney Moonshot, RegMed XB (Regenerative Medicine Crossing Borders) brings together academic institutions such as UMC Utrecht, patient organizations like the Dutch Kidney Foundation, and industrial partners such as Mimetas.

The long-term goal is the development of a custom-made kidney. Along the way, several promising innovations are being developed that may also improve patients' lives.

## **THE WEARABLE KIDNEY: A SIGNIFICANT INTERIM STEP**

One such innovation is the wearable kidney. "This development will allow patients—who now undergo four-hour dialysis sessions three times a week—to perform dialysis at home, with more freedom and autonomy," says Marianne. "It's a major step forward, even if kidney function remains limited."

## **MINI-KIDNEYS: OPENING DOORS TO NEW POSSIBILITIES**

When we asked Marianne about breakthroughs in the Kidney Moonshot, she responds enthusiastically: "The development of kidney organoids, small lab-grown pieces of kidney tissue 'mini-kidneys'- opens an incredible range of possibilities. This allows us to better understand the functioning of healthy kidneys and provides new insights into disease mechanisms by growing kidney tissue from patients. For example, we can even use the organoids to test new medications."

Within the Kidney Moonshot, Marianne's research group, works alongside that of Ton Rabelink in Leiden. The various groups collaborate and complement each other. Ton Rabelink is working on mini-kidneys derived from induced pluripotent stem cells (iPSCs). "The cross-pollination between different groups within the Kidney Moonshot alone is incredibly valuable," Marianne says. "For example, from the mini-kidneys from Leiden, we can learn a lot about kidney development, while your own focus provides insights into repair processes in adult kidneys."

Marianne adds: "Ultimately, we aim to develop a truly custom-made kidney using a patient's own tissue. Kidney organoids could play a major role—initially perhaps in combination with the wearable artificial kidney. With help from smart materials developed at Eindhoven University of Technology, for example, we may eventually succeed in creating a fully personalized kidney."

## **A BIGGER, STRONGER ECOSYSTEM**

Collaboration remains a crucial theme that repeatedly surfaces during the interview with Marianne.

"What makes RegMed XB's Moonshots so unique is the close collaboration between medical, biological, and technological disciplines. And there's also cross-pollination between the Moonshots. That's a huge strength."

She cites bioprinting—the 3D printing of cells and tissues—as an example:

"Bioprinting technologies developed in the Osteoarthritis Moonshot, for instance, are now also benefiting the Kidney Moonshot."

"Fundamental research is the foundation of innovation. In 2017, we received a major NWO Gravitation grant for the Materials-Driven Regeneration program—a collaboration between researchers in Eindhoven, Utrecht, and Maastricht."

This effort was followed up in 2024 by the prestigious NWO Summit Grant for the joint DRIVE-RM research consortium. These programs are an important source of new discoveries and research breakthroughs. Together with RegMed XB's focus on clinical translation, valorization, and implementation, these programs form a powerful and complementary Regenerative Medicine ecosystem.

Another critical component is the RegMed XB Pilot Factory, a national facility that helps researchers and companies to bring new regenerative therapies to the market. It is also of great value to the Moonshots, Marianne explains: "This facility enables researchers to scaleup discoveries and bring innovations to the market and thus to patients more quickly."

## **PATIENTS AND ETHICS INVOLVED EARLIER IN THE RESEARCH**

From the beginning, RegMed XB has involved patients, health funds, and patient organizations in its work. "They actively participate in meetings, and they play a key role in shaping our research. This leads to research that better meets patients' needs."

Ethics, health economics, and regulatory aspects are also considered from the earliest stages. "This is very important," Marianne says.

"It would be a shame to develop something that turns out to be unfeasible due to legal or ethical constraints."

Marianne explains. "We need to think about implementation from the start to ensure patients actually benefit."

## **EVERYTHING COMES TOGETHER IN THE CUSTOM KIDNEY**

When we ask Marianne about her vision for the future, she explains: "Mini-kidneys have given the field an incredible boost. We're now doing things we couldn't even imagine a few years ago," says Marianne. "That's the beauty of science—it's unpredictable. Progress can accelerate suddenly, or unexpected setbacks can occur."

With determination, she concludes: "We are now working with the Dutch Kidney Foundation on first-in-human clinical trials to investigate the effects of the wearable artificial kidney."

At the same time, we're pushing forward on mini-kidney development. Ultimately, I believe that through this combination of knowledge, collaboration, and smart materials, we will not just repair—but truly regenerate—kidney function. A custom-made kidney for patients with kidney failure."

**Within the RegMed XB Kidney Moonshot, the Dutch Kidney Foundation, scientists, companies and governments collaborate.**