KidneyX Summit Highlights Innovative Approaches to Kidney Care

By Melanie Padgett Powers

Every day, 13 people die in the United States while waiting for a kidney transplant, and those experiencing dialysis face a 50% mortality rate during the first 5 years of treatment. Communities of color are disproportionately affected, with increased incidence, fewer organs available for transplant, and poorer outcomes overall. The successful creation of an artificial kidney would revolutionize kidney care in the United States, likely saving lives with more transplants, shorter transplant wait times, alternatives to transplants, and less need for dialysis.

More than $9 million was awarded to eight research teams working on innovative approaches to developing a bioartificial kidney at the 2023 Kidney Innovation Accelerator (KidneyX) Summit on June 12, 2023, in Washington, DC. The KidneyX prize competition—now in its fifth year—is a public-private partnership between ASN and the U.S. Department of Health and Human Services. The program has held six competitions, awarding approximately $17 million to 75 winners in 26 U.S. states.

Supporters in Congress are now calling for a funding increase to $25 million for KidneyX in the 2024 federal fiscal year.

“KidneyX is engaging community researchers and investors to bring breakthrough therapies to Americans with kidney disease,” said Admiral Rachel L. Levine, MD, U.S. Assistant Secretary for Health, in her closing keynote at the KidneyX Summit. “Through the power of prize competitions, we have the opportunity to transform lives and generate new solutions for kidney care. Prize challenges are different from science grants because they expand the solution space beyond just academia and researchers. Prizes are an open innovation tool to bring nonprofits, researchers, and governments together while stimulating niche markets and neglected markets like kidney care was before KidneyX.”

The 2023 winners fell into two tracks: 1) accelerating the prototype of a bioartificial kidney and 2) components and tools that enable the development of an artificial kidney.
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Kidney. Before the winners explained their approaches at the summit, KidneyX Steering Committee member and patient David Rush, in his morning keynote address, encouraged researchers and physicians to remember why they are doing this. “It’s not just me going through kidney disease; it’s my kids, it’s my wife, it’s my family, it’s my support system,” said Rush, who is undergoing home dialysis after his transplanted kidney failed in 2017 after 7 years. “When you’re doing these things, you’re not just doing it for me. You’re doing it for future generations. Remember your why. Remember why you wanted to become a doctor, remember why you wanted to be a nurse…. Don’t lose that vision.”

Transplanting pig kidneys into humans

Two of the prize winners are trying to make it possible to transplant genetically modified pig kidneys into humans. Xenotransplantation researcher David K.C. Cooper, MD, PhD, FRCS, of Harvard University, believes this is the solution to increasing the supply of available kidneys for transplant. His team has successfully transplanted pig kidneys into primates, with the kidneys functioning for more than 1 year in several of the animals and one kidney functioning for 4 years. But the results are not consistent enough yet for the U.S. Food and Drug Administration to allow human trials, he explained. “To improve success, his team needs to develop a better immunosuppressant regimen,” Cooper said. He is hopeful they will see success in a couple of years, which would open the door for human trials.

Cooper pointed out that 45% of patients receiving dialysis are taken off the transplant waiting list because they have died or have developed co-morbidities that make them unsuitable for transplant. He believes those patients should be the first to be offered a pig kidney. “One day, organ transplantation from deceased human donors, I think, will be of historic interest only,” Cooper said. “People at a meeting like this in 30 years’ time will say, ‘Once upon a time, they actually transplanted kidneys from dead people—can you believe that?’”

Like Cooper, Matt Tector, PhD, chief scientific officer at Makana Therapeutics, is also working on using pig kidneys for humans. Tector’s team is trying to solve the challenging fact that every human has antibodies to every pig, which would cause the human body to destroy a transplanted pig kidney in minutes or hours. His team selected 44 patients on the kidney transplant waitlist to evaluate how their antibodies bind to the cells in genetically modified pigs. They discovered that knocking out one or two genes was not enough. But by knocking out three genes, the human anti-pig antibodies fell to an acceptable level. Next, they tested the three-gene-knockout pigs on 822 patients and found that 40% of the patients fell into the detectable but manageable level, whereas 30% of patients had no detectable antibodies. They tested the three-gene-knockout pigs on 822 patients and found that 40% of the patients fell into the detectable but manageable level, whereas 30% of patients had no detectable antibodies. Next, they tested the three-gene-knockout pigs on 822 patients and found that 40% of the patients fell into the detectable but manageable level, whereas 30% of patients had no detectable antibodies.

Cooper emphasized the excitement on the horizon—it’s great to see all the technical staff and scientific things, [but we need to marry] the two between the patient and the technology, making sure that the technology equals some of the patients’ needs and some of the needs of the people involved in the patients’ lives,” Rush said. “We need both of them to co-exist.”

2023 KidneyX winners

Track 1 participants each received $1.6 million, and Track 2 participants each received $1 million.

Tools to develop artificial kidneys

Nephrologist William Chang, MD, PhD, of Yale University, proposes improving care of patients with end stage kidney disease (ESKD) by combining innovations in stem cell technology and tissue engineering with the established clinical practice of peritoneal dialysis. “Kidney organoids can now be generated from patient-derived stem cells,” Chang explained. “But the question is how to use them therapeutically. ‘I believe you can implant these in the abdomen as an augmentation of peritoneal dialysis,” Chang said. “You can then drain fluid and allow filtration to occur.’ Advantages include that the stem cells are derived from the patients, reducing infection risk, and that peritoneal dialysis is well-established and is the preferred form of dialysis by many patients with ESKD, Chang noted.

Biologist Shuvo Roy, PhD, of the University of California, San Francisco, aims to provide patients with a small, implanted, bioartificial kidney. Roy’s team has developed a bioartificial kidney that uses a mechanical hemofiltration unit and a bioreactor with engineered renal tubule cells. Importantly, patients with the device would not need treatment of immunosuppressive drugs, he said. The team has successfully implanted and operated the device in pigs for 7 days without immunosuppression. Roy estimated his team needs approximately $20 million and 3–4 years to get through the first clinical human trials. “If we do that, we’re able to get to something that will provide patients a better quality of life and save costs and allow us to change how end stage renal disease is treated,” he said.

Vascular biologist and tissue engineer Ben Shepherd, PhD, is co-founder and chief executive officer of Trestle Biotherapeutics. His team focuses on regenerative medicine. They aim to develop implantable therapeutic tissue that would replace the kidney, using a patient’s own stem cells to grow more cells and then a new kidney in the laboratory. This would be a solution that restores renal function, that provides freedom of mobility, that doesn’t come with an increased risk of infection, [and] that doesn’t come with an increased risk of cancer,” he said.

Shepherd explained that all of the technology his team needs already exists; the challenge is putting it all together. “[At Trestle, we are] taking newly formed stem cells and creating cells that will become the kidney, organizing those into miniature organs that contain blood-filtering units that are essential to renal function. And we’re now using 3D bioprinting techniques to make larger tissue with interconnected, fluid-filled channels so that we can mature that tissue and get it ready for transplantation. But to be clear, there’s a long way to go,” Shepherd continued. “Some of these things are more advanced than others. Some simply require more capital and research and development. And some, we must understand much better before we could ever safely administer them to a patient.”

As the KidneyX Summit came to a close, Rush reiterated the importance of developing technology that would realistically work with patients’ lives and their needs. “With all the exciting things on the horizon—it’s great to see all the technical stuff and scientific things, [but we need to marry] the two between the patient and the technology, making

References


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