



Updated
FAQ
Version 3.0

[Updated] Frequently asked questions sourced from and designed for patients living with end stage renal disease (ESRD) answered by Drs. Shuvo Roy and William H. Fissell. -- *February 2016.*



The Basics – The Device & Its Function

How does the device work? And how big is the device?

The bioartificial kidney, the size of a coffee cup, consists of two modules that work together to get rid of wastes. First, a hemofilter module processes incoming blood to create a watery ultrafiltrate that contains dissolved toxins as well as sugars and salts. Second, a bioreactor of kidney cells processes the ultrafiltrate and sends the sugars and salts back into the blood. In the process, water is also reabsorbed back into the body, concentrating the ultrafiltrate into “urine,” which will be directed to the bladder for excretion.

What is the surgical process like to insert the device? Where can I have the procedure done?

The procedure will be similar to kidney transplant surgery and it will be performed under general anesthesia.

How will the filter be cleaned?

The filter is coated with a special thin biocompatible film to prevent fouling and blood clots. Additionally, the blood flowing over the coated filter surface will also help to keep the membrane free of debris accumulation.

How long will the device survive after implantation? Will it have to be replaced?

The device is meant to be permanent and that is what our efforts are pushing towards. Current testing and research suggest that it could be possible for the device to operate for many years, without failure. However, if failures occur, the replacement of the filter and/or cells would involve a minimally invasive surgery.

Will there be a risk of blood clotting? Will patients still have to take immunosuppressive drugs or anticoagulant after implantation?

The possibility of having to take immunosuppressive drugs or anticoagulants is minimal, and even non-existent. While we will certainly have better insight as we progress through the pre-clinical trials phase, the cells in the bioreactor are isolated from the patient’s immune system and the surface coating on the device will work to prevent blood clotting.

How are the cells in the bioreactor simultaneously isolated from the immune system but still kept alive?

The immunoisolation is provided by the membranes on which the cells are grown. The cells are grown on a porous scaffold which allows water, salts, glucose, amino acids, and other very small molecules to pass through it freely. These nourish the cells and allow the cells to dispose of small wastes, such as carbon dioxide.

The immune system relies on fairly large molecules to identify and attach foreign intruders, which are a thousand times larger than, say, glucose. They are too large to penetrate the sieve of the membrane supporting the cells.

Will it also help Polycystic Kidney Disease and Focal Segmental Glomerulosclerosis (FSGS)?

Yes. In any case where a kidney transplant is needed, our device will be a viable option.

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Will the "cell reactor" part of your kidney be able to generate Erythropoietin and eliminate the need for artificial EPO injections?

The kidney cells in the bioreactor are different cells than the cells that secrete erythropoietin.

What kind of GFR value would you expect to see once this device gets implanted in you? How much increase in GFR might occur?

While this will be confirmed as we progress through pre-clinical studies, we anticipate an initial GFR target value of 20-30 ml/min with this device implanted.

Can you still get this device if you still have 15% kidney function? Or is it exclusive to those whose kidneys have totally failed?

This is case-specific, so it would depend on the details of a particular patient's case and will be decided by both the patient and physician.

Will this be available internationally? Or will international patients have to go to United States for procedure?

Once the device is released commercially, it will be available to all patients in need, domestic or international. Clinical trials, however, will likely be conducted in the United States initially because it is where the key research is taking place as well as needing to adhere to all FDA guidelines.

Any predicted side effects?

Adverse side-effects that might occur would be similar to side effects known in other procedures involving implanted medical devices, and would possibly be associated with surgical traumas and infections. Additionally, there might be a need for increased fluid consumption.

How much will this device cost?

We are unable to say with certainty how much the device will cost, due to what the business and economic climate will be like by the time it is released. Nevertheless, we anticipate that the device will cost no more than what transplant maintenance currently costs.

Will this device be covered by insurance?

Generally, medical devices that are successful are products for which insurance provides coverage. As our analysis suggests, the implantable bioartificial kidney will be associated with over 50% cost savings compared to dialysis and, as such, we anticipate that the device will be attractive to those considering coverage decisions.

What are the challenges (long term and short term)?

The Kidney Project is an ambitious project and is not without its challenges. In the short term, our primary challenge is funding the research. A significant hurdle is procuring enough money in order to proceed through the preclinical studies, which would allow us to build full-scale prototypes to generate data for the first round of in-human studies.

The long term challenges center around keeping the device operating trouble-free after implantation beyond a few months. Some of problems we won't hit until we conduct clinical trials, so for now, we are looking at ways to increase the functional lifetime of cells as well as ways to

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minimize, or even eliminate, thrombus formation (blood clotting). We will get a better handle on the long-term challenges once we transition to pre-clinical studies and begin to gather clinical-scale data.

*Continue on to the next page for questions about the Timeline.

The Timeline

What can be done to speed up the research and development process?

If we received all necessary funding in a timely manner, the earliest we can envision arriving at Clinical Trials is late 2017. There are a series of pre-clinical trials needed to get a complete device to patients and, while funding might not necessarily move the 2017 start date, funding will certainly change our ability to follow initial success with definitive trials for approval and coverage. See *below for more details on funding.*

If you had full funding, when would the device be ready for clinical trials?

If we successfully raise all of the necessary funding, mentioned above, and we do not encounter any unanticipated development challenges, we expect to have a device ready for Clinical Trials in the year 2017.

When will the device be ready after clinical trials?

Typically, there are at least two cycles of clinical testing required for all medical devices. The nature of the results of the first round of clinical trials will largely influence the timing of release and industrial-scale manufacturing.

That being said, we estimate that the clinical trials will be complete by the year 2020. During the clinical trials, we will be working with manufacturers to discuss and manage the details of production. Once the clinical trials are complete, the device will be immediately available for patients.

The Funding

How much more money do you need to arrive at Clinical Trials by the end of year 2017?

In late 2015, we received a significant grant from the National Institute of Biomedical Imaging and Bioengineering (NIBIB), one of the National Institutes of Health (NIH), amounting to \$6 million to be distributed over the next four years – roughly \$1.5 million per year. So, this gives us \$3 million by the end of 2017, which means we still have a funding gap of \$10 million if we are to meet the earlier timeline.

To fill this gap, while we are continuing to apply for more federal grants and reach out to private foundations, we are also relying on grassroots fundraising campaigns. This makes fundraising efforts even more vital.

Why, at this point, is progress dependent on funding?

The project has both science goals and engineering goals. For example, an engineering goal for the development of the implantable bioartificial kidney is to test a library of candidate cartridge geometries in real-world pre-clinical settings. This takes money to hire programmers and server time to implement and run blood flow simulations, manufacture prototypes, conduct the surgeries, and analyze the data. Twice the money speeds up the progress because we can have two programmers working side by side on different designs, rather than one after the other. We can have two surgery experiments running simultaneously instead one after the other. We can manufacture twice as many silicon filters. The money significantly shrinks these timelines.

Science goals, however, such as determining essential cues that prevent bioreactor cells from becoming senescent in culture, are less predictable and less linear than engineering goals. These science goals will be attained, but the progress doesn't directly scale with finances.

We would like to get to first-in-human trials of this technology without surrendering total control of the technology to short-term for-profit interests. Government agencies and philanthropic investors have a different idea of the returns they seek (human life) and a different time scale decade or more than venture funds who need to return money to investors in 5-10 years typically. The short term needs of capital are at odds with the needs of the technology and ultimately the needs of patients.

What kind of federal funding do you receive? How do you get more?

In addition to our recent NIH award of \$6 million (to be distributed over the next four years -- \$1.5 million per year), we have received almost \$7 million from various federal agencies in the United States, namely National Institute of Health (NIH), National Aeronautics and Space Administration (NASA) and the Department of Defense (DOD), who provided funds for the basic research and groundwork behind the artificial kidney. We have since received very positive feedback from these federal agencies, recognizing our success with the fundamental proof-of-concept work. In order to proceed to the next steps in commercialization, we now need the help of industry partners and investors. However, as mentioned below, the challenge with procuring these industry partners and investors is that they want to see more data from preclinical studies before they invest.

The Funding

Why do you not have a lot of investors? Is it too risky for them?

Investors have expressed interest in the concept of our project and have indicated their understanding of its potential. Additionally, they have also commented that their comfort with investing in our project would increase significantly once we can show them evidence of the device working in an animal for at least 30 days. This is what we are currently working on.

Is it worth contacting our government officials to ask for more funding to your project?

Yes, absolutely! The Kidney Project's artificial kidney will enhance patient outcomes and reduce treatment costs, which provides an overall improvement to the patients' quality of life and current healthcare costs.

How can I make a donation? (Domestically and Internationally)

Online

Visit <https://kidney.ucsf.edu> and click on the "Make a Gift" link in the left-hand menu or at the bottom.

Mail

Make checks payable to: UCSF Foundation.

Include allocation instructions on the memo line: The Kidney Project.

Send gifts by U.S. Mail to:

UCSF

P.O. Box 45339

San Francisco, CA 94145-0339

Phone

Call toll-free 877/499-UCSF (877/499-8273) to charge by phone.

If none of these options work for you, you may contact Stephanie at stephanie.brummett@ucsf.edu

Clinical Trials – Before & After

What is the status of pre-clinical testing?

Currently, we have tested components of the device successfully, but we still need to integrate these components into a single device that will be implanted and operated for at least 30 days.

To date (December 2015), we have demonstrated filtration as long as 24 days and vascular patency as long as 36 days in one experiment.

We are building large scale devices to test filter material for blood clot resistance. For the bioreactor, we are conducting experiments to demonstrate blockage of immunological molecules that can attack the cells. We are also comparing conditions inside the bioreactor that allow for cells to grow and remain healthy.

Do you have a waitlist for clinical trials? How do I sign up?

If you are interested in potentially participating in the clinical trials, please complete this form to submit your information into our [confidential] database:

http://bit.ly/Database_Form

Please note that while we can't guarantee anyone's participation since this is not an official "wait-list", we can guarantee that we will contact everyone in our database when we draw nearer to clinical trials, still anticipated to begin by the end of 2017, provided we receive enough funding.

What are the criteria for choosing first group of clinical trials patients?

We are currently working with the U.S. FDA to finalize these details, but we anticipate that we will be looking for patients who exhibit high levels of antibodies and have been on the transplant wait list for a long time.

Will stage 4 chronic kidney disease patients be accepted?

Initially, clinical trials will concentrate on End Stage Renal Disease patients.

Will international patients be considered?

International patients will certainly be considered. However, it is likely that the first round of patients will be domestic due to logistics and FDA (Food and Drug Administration) guidelines.

Will there be a trial for pediatric patients?

Safety will be our main concern during the initial phase of clinical trials, so we do not intend to expose vulnerable populations, such as children, until after we have positive and consistent data from clinical trials with adults.

Will patients have to relocate to Bay Area for duration of clinical trials?

At this stage of the project, logistics of the clinical trials are not certain. That being said, the trials will likely be held at multiple sites, including the Bay Area, so the patient will not be required to relocate to the Bay Area.

Will the clinical trials be fully funded or will the patients need to help with funding their participation?

Ideally, if we have procured all necessary funding, the clinical trials should be fully funded. We will know more details as we get closer to clinical trials and will update everyone accordingly.

Getting Involved

Where can I find updates regarding the progress of the project?

Our Facebook page is a great place to stay informed about our progress:

<http://facebook.com/ArtificialKidney>.

In addition, we keep an archive of news and events on our site: <http://kidney.ucsf.edu>

Is there a way to help get the artificial kidney closer to reality?

There are two main ways: firstly, by directly helping with funding either through organized fundraisers in your community or direct donations to the project (*see Funding section for details on how to donate*). Secondly, by raising awareness by sharing our website and Facebook page, publicizing our efforts in the press, and reaching out to interested people or communities.

I'm interested in fundraising for The Kidney Project, how do I get started?

If you are interested in fundraising, great! We welcome everyone who is interested in helping our cause. Please email our Project Coordinator, Stephanie, at stephanie.brummett@ucsf.edu to get more information on how you can help with fundraising.