A Father of HeartMate 3 Wants A Bigger Family

He's glad about its 20,000 implants. But he knows the heart pump can reach so many more to fight heart failure.

Abbott Newsroom Feedback

PRODUCTS AND INNOVATION | Dec. 16, 2021

Spend a little time with Kevin Bourque and the family resemblances clearly start to come through.

His energy ever-present — there is no off switch on the man that we're aware of — he's a whirl as the details flow forth, nonstop. He just keeps pumping them out. Excited, animated, his spirit has a real magnetism. He's almost levitating.

progeny.

He doesn't pull out his billfold to let loose a waterfall of pictures — in part because they're all in the room with him and he'll show them soon enough — though you wouldn't be surprised if he had ...

Here's our first. Big boy.

Here's our second. Smaller, but STRONG.

And here's our third ... so far. A real mighty mite. And so smart!

As one of the fathers of the HeartMate line of left ventricular assist devices (LVAD) — that's so formal, they're heart pumps to family friends like you — Bourque, in his role overseeing research and technology in mechanical circulatory support, has put the best of himself and his team in each new iteration.

It's why they run longer, pump more, stress less and, yeah, levitate with the help of magnets.

And it's why, as we get him to stop — let's be honest, we're just slowing him down for a few seconds before he speeds back up again, like the artificial pulse he and the team put in HeartMate 3 — to acknowledge the milestone of HeartMate 3 being implanted more than 20,000 times, there's *a lot* to take in from the guy who's been there since their conception.

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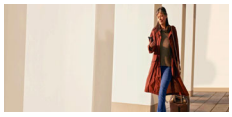

Illness Can Steal Life's Precious Moments. Our Tech Helps Get Them Back.

Bourque Plants His Seeds

Kevin Bourque grew up in Salem, Mass., and if anything was a trial for vexations, it was AP Calculus his senior year of high school.

He entered UMass-Lowell uncertain how his dreams of working in something biomedical would work out.

He left school with his bachelor's and master's degrees in mechanical engineering, "which I definitely do not regret."

And then it was time to get to work.

"My first job out of school, I worked on a diagnostics MRI at a small startup company that ended up going under," Bourque said. "Just before it dipped under the water, I jumped and got this job in 1997. I'm coming up on my 25th anniversary here. I started at Thermocardio Systems, which was acquired by Thoratec and then St. Jude Medical which was acquired by Abbott. So without moving my desk ..."

Another thought enters.

"I still have my original stapler. This is my original stapler."

In case you were wondering.

essentially the same: Keep building better devices to help weakening hearts pump the oxygen-rich blood their bodies need.

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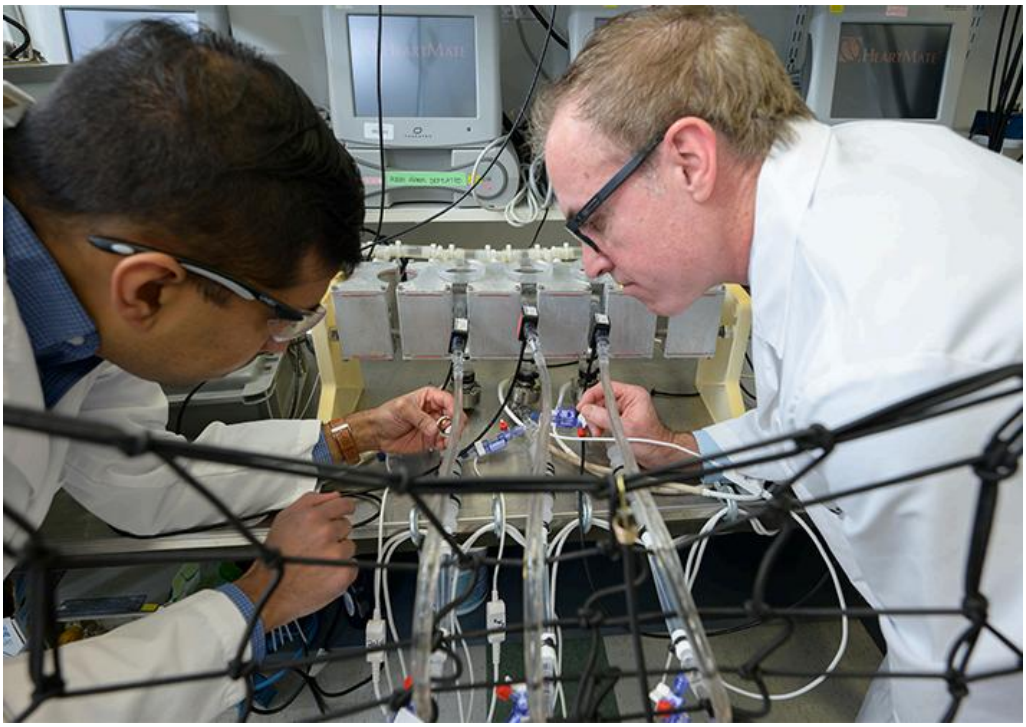

Big Ideas to What HeartMate 3 Is Today

We're gathered here to talk about HeartMate 3 — and if you're uninitiated, the Cliff's Notes version would go something like this: Our latest LVAD works by harnessing the power of magnets that levitate the pump's rotor with high precision, thus lowering shear stresses on blood

risk of thrombosis, stroke and bleeding — so that's where this story starts, kind of like a Tarantino movie which opens at the end before circling back round to see how we ended up here.

Stick with Bourque here.

"We want to work on a mag lev, magnetically levitated, version of a blood pump. So, white sheet: How do we get started? And at the time, we actually tried something that didn't work. But we also get a letter in the mail from Switzerland that — to make a long story short, our brilliant partners, who ultimately became Abbott Zurich and now is our group that does this, that invented the magnetic levitation, still makes our motors for HeartMate 3 — they started a collaboration with us. We licensed the technology and worked on what would become HeartMate 3 but, in those days, it was ... I'll show you one."

Time to bring out one of the kids.

"We had a larger version. This is the original, this is the one I designed."

And so now we've met one of the Heart Pump family.

"So we started in the late '90s on what would become HeartMate 3 to compete with the HeartMate XVE (no longer available). But in the meantime, HeartMate II started doing very well, its clinical trials succeeding.

"So in 2006, we said, 'Let's stop, let's do exactly this (the original, larger HeartMate 3 design) but let's make it

the clinical HeartMate 3 now, a mini one of those. And that's a very fast story to get to where the HeartMate 3 is today."

Get all that? Three generations of HeartMate covering a quarter century in a few seconds.

Like his heart pumps, Bourque just keeps going. And so we are going with him.

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All the Work in a Smaller Package

From the first HeartMate to the current HeartMate 3, Bourque estimates it's half to two-thirds of the volume in size, a shrunken scale that presented wider possibilities for its placement in the body that were just impossible with the original design.

"The original design was exactly the size of a hockey puck," Bourque said. "I'm a big hockey fan."

Again, in case you were wondering.

But they needed something significantly smaller than a hockey puck. So that’s what they designed. And that's a good thing. But that doesn't mean it delivers half to two-thirds the performance. Not at all.

because of the body's needs — even a big guy would need 5 or 6 liters a minute — and we wanted some overhead. So we didn't say, 'Make this 5 liters a minute.' We said, 'Make it 10.' I got 10 from this (the first HeartMate), I want 10 from that (HeartMate 3). And that was the deal."

A deal he's been unwavering in keeping, including his demands to maintain relatively wide passageways in the pump to help reduce shear stresses on blood cells. Bourque refuses to use blood as a cushion, as some other pumps do. "They say, 'You have this mag lev, but why don't you, just in case it fails, have a hydrodynamic bearing as a backup? You just make the gap small even if the mag lev fails, it'll glide on that layer of blood.'

"It's throwing the baby out with the bath water."

This is a guy who loves his babies. But like any good parent, knows they won't all follow the same path. And that meant — and means — keeping an open mind to the possibilities as they present themselves.

"Couple of key things. One, by flipping the rotor upside down, we're able to gain a little bit of real estate. Second, the electronics themselves. Chips are smaller so we shrunk for that," Bourque said. "But then, when we got this small, we said wait a minute, now we don't need to implant it down here (in the abdomen), we can go right in the chest. And that took away this whole business about creating a pocket for the pump and then requiring a conduit between the heart and the pump. We just put this (the inflow cannula, if you're scoring at home) right in the heart. So that made it smaller as well."

which was so complicated it compromised reliability. Nobody wants their heart pump to just quit working.

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The "A-Ha" Moments

When Bourque begins to recount the breakthroughs that opened paths he and his team didn't expect, the brilliant simplicity of those solutions is apparent now.

"The mag lev system was going to be in the same plane as the flow and the flow was going to have to come up and

doing the flow path and I think, 'This is insane, we can't do this' — how about you guys bend those flow pieces down and get the motor out of that plane so that it can have flow in one plane and motor in the bottom plane.

"And they said, 'We can't do that, it will be way less efficient.' "

Bourque, not satisfied but not bound by pride, did what he had to do.

Even if that included some friendly begging.

"Can you pretty, pretty please with sugar on top and try?

"And they came back and said, 'Oh, we just discovered it's actually a little more efficient because the copper is not way out here, it's down here, you actually use less copper so there's fewer losses making it a little more efficient."

It was a similar experience when Bourque specified the rotor be built in titanium. Other engineers were concerned the magnets and rotor wouldn't be able to communicate appropriately through the alloy. But, like a good family, they remain on speaking terms within HeartMate 3. And, best of all, the rotor isn't built of plastic, which was floated as an option vs. titanium.

"I don't want plastic in there for 10 years plus," Bourque said. "I want titanium."

Bourque boils down the conversations:

Can't do it.

Can you try?

Pretty please with sugar on it, can you try?

So we did and it works just fine.

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The Weight of the Wait

He's showing the guts of a HeartMate 3 now and loose parts are making their presence heard. The show now turns to the rotor he flipped upside down.

"At the bottom, there was a stagnation point that we always worried about for thrombosis (blood clotting, which can increase the risk of stroke)," Bourque said. "If I can flip around the rotor to put the impeller at the bottom, then I won't have the stagnation point anymore because the inflow jet will just shoot straight through here, right through that stagnation point. It clears our recirculation problem."

The only problem: "You guys have to put a hole that size through the middle of your motor."

A hole. *Through* the motor.

"They did, and that's what we have now."

After some more bended knee?

little bad asking them to put a hole through their beautiful motor."

He doesn't *really* feel that bad. Because it works how he and they hoped. Just look at the results.

"We got — blissfully — better than expected thrombosis, it's gone to almost zero. We get 1 percent thrombosis. But it's ingested, it's not the de novo thrombosis — we can't keep clots from other places from going through the pump — so better than expected."

So it's better. But it could be better still.

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"Could Be That Every Year."

You know what gets Kevin Bourque's head spinning at 9,000 RPMs, like one of his rotors?

Don't ask him about how HeartMate 3 does its job well. Ask him how much good it can do for so many more people.

Twenty thousand? To Bourque, that's nice but not nearly enough. It's a number that's simultaneously massive and miniscule, a frustratingly enticing reality that, in his mind, doesn't have to stay that way.

"I'm taking it as good news that the U.S. has gone from 3,000 to close to 3,600 heart transplants a year and the patients who benefit most from transplant are getting transplanted. It's what I want."

But it's not all he wants. He wants more. Because he also knows there just simply are not — and probably never will be — enough hearts for every person who needs one.

"The problem is the number of patients who need either transplant or an LVAD are — in the U.S. alone — 60,000

number of transplants is hopelessly small compared to the number of people who need circulatory support. "There are 60,000 heart failure patients who could benefit from an LVAD. So why are we doing 4,000 of them? I can't explain it. And that's, by the way, the U.S. Rest of the world is even more on top of that. It's a little hard to understand."

He certainly grasps part of it.

"How it's presented" can be determinant, Bourque acknowledges. "If the doctor says 'Hey, look, here's your choices: You can do transplant and if you get lucky, you get an organ ... or I could give you one of *these things*."

The put-on disdain is dripping.

"You wouldn't want that. No matter what one of *these things* is."

Now he's really humming.

"If you hear a doctor tell you, 'You have cancer,' most people in the world will say cut it out, do whatever you have to do," Bourque said. "Whereas when a doctor says you have heart failure, they say, 'Ugh, do I have to take a pill every day?' They don't realize it means you're dying and it's a progressive disease and there's no cure. They don't think of it that way."

And so, when he thinks about 20,000-plus implants so far, "Could be that every year."

And he wishes it was, to extend and save more of those 60,000 lives, to make the HeartMate 3 family much larger than it is right now.

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Another Branch on the Family Tree

Being the family man he is, Bourque and his team have been getting busy on the next generation.

Sure, the artificial pulse could be smarter. There are also concepts for FILVAS (fully-implanted left ventricular assist system), where the pump and its power supply would sit entirely inside the body. As you can imagine, it's incredibly complex.

And whatever comes, it has to be a machine that never stops, like dad.

This is all the time can we spend with Kevin Bourque.

This pause, slowing him down for just a moment, has gone over the time allotted.

He needs to get back to speed with his team, building out their family of heart pumps. The new ideas will continue to flow forth, nonstop. They'll keep pumping them out. They're excited. And he’s excited, animated and actually, yeah, he's so wound up now that he is levitating.

For the betterment of tens of thousands of lives, that's a good thing.

And count on this: He'll keep working to make it a better thing.

IMPORTANT SAFETY INFORMATION

HEARTMATE 3

HEARTMATE II

INDICATIONS, SAFETY & WARNINGS

Indications and Important Safety Information

Rx Only

Brief Summary: Prior to using these devices, please review the Instructions For Use for a complete listing of indications, contraindications, warnings, precautions, potential adverse events and directions for use.

Indications: The HeartMate II™ Left Ventricular Assist

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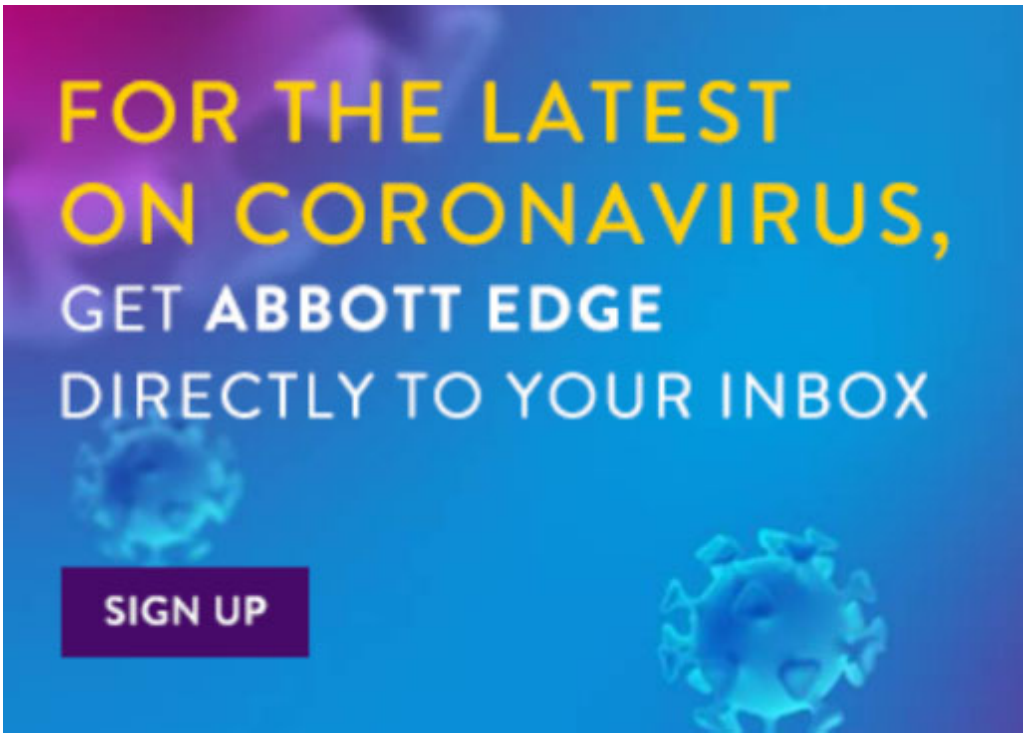

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