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ENDIATX

TRAILBLAZERS IN THE FIELD OF TINY MEDICAL ROBOTS

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Remember the 1966 classic film *Fantastic Voyage* in which a submarine carrying scientists is shrunk to microscopic size and injected into the bloodstream of an ailing colleague to help save his life? It was a pivotal moment in the plotline when the miniaturized crew made their way through the patient's blood vessels to the brain to remove a harmful blood clot. The scene left the audience enthralled and in awe, wondering if such capabilities were possible in real life.

While shrinking technology is still far from reality, with advancements in nanotechnology and robotics, the idea of an army of minuscule robots patrolling our bodies and maintaining our health is slowly sneaking out of the realm of science fiction. Researchers are now taking huge steps in designing micro and nanobots that can be used to carry and release drugs throughout the body, diagnose conditions, and perform medical procedures at microscopic scales. Torrey Smith, co-founder and CEO of Endiatx, a Redwood City, CA-based medical devices startup is one such trailblazer, whose unfaltering drive toward developing ground-breaking technology helped him create a name for himself and his company in the healthcare industry.

An aerospace engineer, Smith, has been in the startup medical devices industry for over 14 years now and is responsible for designing numerous innovative devices and participated in three successful medical device company exits. With his friends and colleagues, Dan Moyer, James Erd, and Alex Luebke—who serve as Endiatx's CTO, principal R&D engineer, and chairman and board of directors, respectively, Smith co-founded

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a few glasses of water during the morning, and swallow PillBot™ along with a pint or two of water at lunch. PillBot™ will yield high fidelity video, be controlled through a tablet in real-time, and does not require the patient to wear a specialized belt or lay down on an expensive piece of capital equipment. It is a 15-minute procedure; as opposed to the traditional upper endoscopy, patients do not have to stay back at the hospital to recover. What's more? It is sedation-free, wireless, non-invasive, and cost-effective. During the process, patients can swallow the PillBot™ and watch the doctor quickly navigate it inside their stomach with an Xbox-like controller. Drawing a fun analogy, Smith enthuses, "The tiny robot is like a drone quadcopter. It has four little electric motors, four little propellers, and swims inside the stomach of the patient just like a drone flying in the air. Doctors can control its movement via a live video feed. It is almost like playing a video game but inside the human body." The device's video

Endiatx after realizing the limitations and drawbacks of using traditional endoscopes and passive pill cameras to diagnose conditions in the GI tract. "Endoscopy typically involves sliding a long, flexible tube with a light source and camera into the body of a patient. The issue with this procedure is it not only requires the patient to be sedated but also carries its own risks of perforation," says Smith. On top of that, endoscopes can't reach everywhere. As an alternative, scientists came up with the passive pill cameras; however, their lack of therapeutic capabilities, inability to obtain biopsies immediately, and lack of any active control over the movement of the capsule led to numerous challenges.

"With Endiatx, our goal is to disrupt the common but very uncomfortable endoscopy procedure—replacing it with a non-invasive process that does not require anaesthesia. You could even swallow PillBot™ in your living room and have your doctor control it over a video call," informs Smith. Endiatx has developed a series of pill-sized robots, PillBot™, to perform remote diagnosis within the GI tract. PillBot™ features a novel propulsion system that enables doctors to actively control the device and have real-time remote access to the entire GI tract, beginning with the stomach. With this innovative device, Endiatx is giving physicians the diagnostic power of an endoscope in the form factor of a pill.

Unfolding the Smart Pill Revolution

Endiatx is designed to help doctors diagnose illnesses within the GI tract more seamlessly. For now, the initial target is the stomach, where a patient can simply skip breakfast, drink



With Endiatx, a typical patient will be able to receive an active upper endoscopy in the comfort of their own living room as their doctor pilots PillBot™ over internet protocol- this is Telemedicine 2.0

game-like interface lets doctors perform endoscopy in ways they simply haven't been able to, until now.

Endiatx's PillBot™ is in the final stages of R&D; the team is working on addressing standard issues like extending the battery life of the device and getting higher quality video. The firm has, in fact, successfully demonstrated 17 robots through people to date and is currently preparing for a trial with the FDA. "The feedback has been very exciting. It is the first time a micro-robot has been operated inside the human body—completely autonomously; no wires, no cords, no connections. It is an easier, faster, and better alternative," informs Smith.

Revolutionizing Diagnostics and Treatment Options

The initial motivations and concept behind Endiatx were fed by Smith's interests in science fiction. Through his

experience as a medical device designer, he saw that the healthcare industry was typically risk-averse. "It seemed like everyone was searching for low-hanging fruit, and larger ideas tended to stall out in favor of a quick buck," asserts Smith. "Our aim with Endiatx was to create tiny robots that will make routine screening of deadly diseases easy, fast, and cheap while moving through the body performing standardized procedures such as colonoscopy."

The name of the company, Endiatx, itself is telling: the 'End' signifies 'Endo' meaning 'inside,' 'dia' stands for 'diagnostic,' and the 'tx' denotes the medical shorthand for 'treatment.' The founding team's vision for Endiatx's technology very much involves treatment: a controllable capsule that acts as a platform where onboard tools can do more than just take the footage, perform a precise biopsy anywhere inside the GI tract, or even make an active remediation, like snipping a polyp in the intestine. In other words, the organization's focus is to enable safe, convenient, affordable diagnoses and procedures within the body.

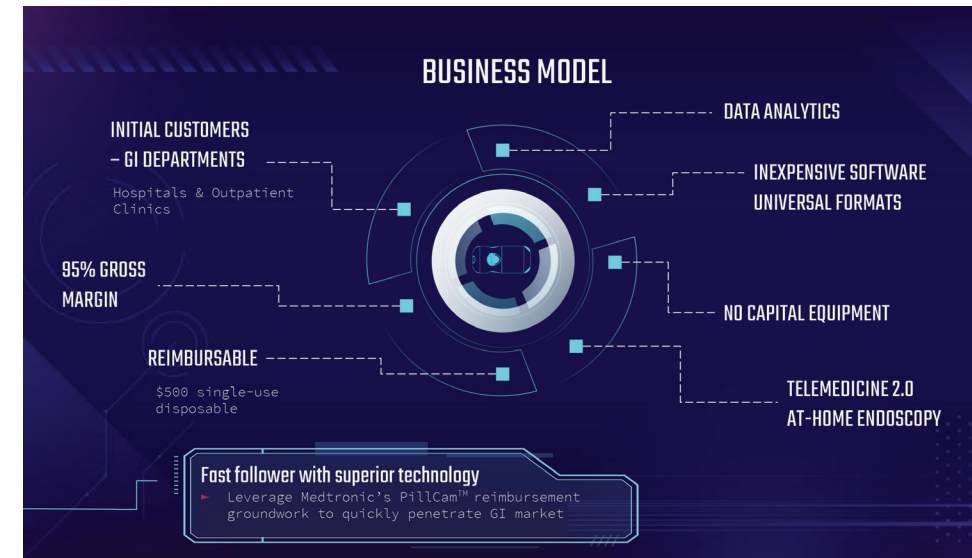
To that end, down the line, the firm plans to come out with two more products including Pill Surgeon™ and Micro Surgeon. Pill Surgeon™ will feature surgical instruments that can be extended out of the device to take tissue samples and do microsurgeries, cauterize bleeds, and serve as a platform for physicians to perform interventional medicine. "With Micro Surgeon, we are guided by the field of Biomimicry. Imagine a rice-grain sized robot along the lines of a bot fly larvae. A robot like this could go anywhere in your body, even perform brain surgery," asserts Smith. "If nature can do it, we can do it, and we can give doctors lifesaving tools they've only ever dreamed of."

Dedicated to Continuous Innovation

While several factors have played a significant role in Endiatx's success, the founding team's diverse background and combined experience in the medical device arena enable them to soar above the competition. Moyer, who possess a master's degree in both electrical engineering and computer engineering, has worked for Apple Special Projects group and is adept at designing all kinds of medical devices and flexible electronics. "He is the wizard of our team. He designs all the electronics and the hardcore code that goes on to the robots," adds Smith. Erd, on the other hand, is a classically trained machinist, who is proficient at operating heavy machine tools and ardent about innovation

and creation. "When people say 'hardware is hard', they obviously don't have James Erd," says Smith. Luebke holds a doctorate in aerospace engineering from Stanford University and has worked in the military and the space industry, served at Google X, and been a C-level executive for multiple startups. "Each one of us is dedicated and strives to create new technologies that allow medical professionals to better explore the human body, while minimizing patient discomfort," states Smith.

Since its inception in early 2019, Endiatx has grown exponentially and added several feathers to its cap. In just 20 months, the firm has filed five patents, trademarked its innovative offerings, carried out clinical trials, and burned less than \$400,000 investor money. When it comes to the future of Endiatx, the team has ambitious strategies. As the next step, the firm is waiting to conduct institutional



review board (IRB) trials of the PillBot™ under the guidance of some world-class regulatory, clinical and quality experts and turn its current prototype into a market-ready product. The firm plans to crystallize the minimum viable product of PillBot™ in Q1/Q2 of 2021 and is targeting market approval of PillBot™ from the FDA in Q3 of 2022. Alongside, the firm is planning to develop a new product, one that physicians can use to give routine pancreatic cancer screenings. "This is just one example of what our technology can possibly do. We aim to be the 'NASA' of the human body and go after problems we never thought we could," appries Smith.

When one considers the breakneck progress in technological miniaturization and the rapid evolution of Endiatx over such a short period of time, the future of miniature robots in medical diagnostics and treatment seems limitless! 🚀