

MEANINGFUL INNOVATION THE SPIRIT THAT DRIVES US



With costs on the rise, and a focus on delivering better outcomes, a new era of healthcare is upon us. Powered by an unwavering Mission to improve lives, Medtronic teams are uncovering the potential that today's technology offers, both near and long term. Together — with partners spanning several disease states, industries, and geographies — we combine a patient-centric mindset with the expertise and application needed to make a difference for patients, providers, and health systems around the globe.

RON BROWN WRITES A LETTER TO MEDTRONIC EVERY YEAR

The husband, father, and grandfather has lived with the help of Medtronic technology since his 30s, when he received his first cardiac pacemaker. His annual letter is read to employees around the holidays, and is a subtle reminder of why we do what we do. "Without your products," he tells the crowd, "I would be a fading photograph in a family album."

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Co-founder, Earl Bakken, etched the concept of **meaningful innovation** into everything at Medtronic. His passion to "put things together, differently" inspired Bakken to develop the first wearable, external, battery-powered, transistorized pacemaker in 1957. That passion — combined with a Mission to improve the lives of patients — remains strong at Medtronic seven decades later.

Today, our therapies help two people every second.¹ With 84,000 employees working across 160 countries, developing patient-focused innovation — and strong partnerships — remain key to an even better, more impactful future.

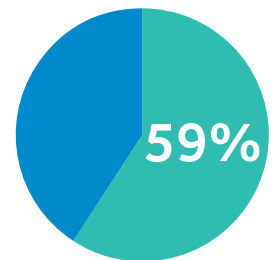
"The only way to step into the future is to see further than what we can measure, beyond what we see, and understand what could be a possibility," says Medtronic Vice President of Corporate Science, Technology, and Clinical Affairs, Michael Hill. "As Earl Bakken told us, 'Look beyond the apparent; nothing is impossible.'"

PATIENT-INSPIRED TECHNOLOGY FUELS 21ST CENTURY HEALTHCARE

The number of people who use connected devices to monitor their health is forecasted to grow sevenfold by 2021, from 7.1 million in 2016 to more than 50 million.² With the advent of remote monitoring, wearables and telemedicine, and 30 percent of healthcare spend attributed to administrative costs³, the potential is high to significantly impact cost — and outcomes — through monitoring and treating patients in new and different ways.

50M:
Individuals
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Our teams have developed technologies and solutions that help anticipate, adapt and react to patient needs beyond the hospital setting. More recently, a global study of heart failure patients indicated certain benefits of a specific Medtronic algorithm, found on the company's cardiac resynchronization therapy (CRT) devices, compared to conventional biventricular pacing therapy. The research showed a 46 percent reduced risk of atrial fibrillation (AF) events⁴, and a 59 percent reduction of a patient's odds of a heart failure hospital readmission within 30 days.⁵



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"The algorithm's personalized therapy helps keep more patients out of the hospital. On a system-level, this results in savings and less use of healthcare resources."

Medtronic
Further, Together

“The study results are clear in showing that CRT devices with adaptive algorithms reduce the risk of AF adverse events and related costs,” said Prof. Dr. Med. Bernd Lemke, head of the Department of Cardiology at Lüdenscheid Hospital, Germany. “On an individual level, the algorithm’s personalized therapy helps keep more patients out of the hospital. On a system-level, this results in savings and less use of healthcare resources.”⁶

Like artificial intelligence (AI), great potential exists in areas such as biosensors, augmented reality, and material science. Additive manufacturing (3D printing) in the industry, alone, is expected to nearly triple by 2021.⁷

Navigating this new era of even more personalized, precision medicine, our people work with patients and clinicians every day to identify and address unmet needs across the healthcare system.

“A lot of companies have mission statements, but here, it’s a very patient-centric mission that drives us,” says Mark Phelps, an electrical engineer who led an exploratory project more than 10 years ago called Deep Miniaturization. At the time, Medtronic employees recognized the potential benefits to patients if implantable devices could be 90 percent smaller. Now, the world’s smallest pacemaker, and an insertable cardiac monitor that is the size of a small battery — both built on the technology Phelps and his team developed — are helping patients around the globe. [Read about Deep Miniaturization.](#)

These advances take time and teamwork.

“We hire people from different industries and different backgrounds, and get the voice of the customer from all over the world to bring new ideas together in a meaningful way.”

“It starts with the first principles of science. You have to understand physics, biology, mathematics, and chemistry, and how materials and systems change when exposed to different environments,” says Mark Breyen, a senior R&D leader at Medtronic. “We also hire people from different industries and different backgrounds, and get the voice of the customer from all over the world to bring new ideas together in a meaningful way.” Breyen keeps a photo on his wall of a patient helped by several devices he created, as a reminder of why he works at Medtronic.

Diversity of thought, and a continuous cycle of input from patients and providers, informs the teams trying to develop solutions that will work in today’s tech-driven, connected world.

3X
3D printing is expected to triple by 2021⁷

“The care I feel is unsurpassed,” says Donna Pomeray, a deep brain stimulation patient invited to Medtronic to discuss ways the technology she relies on can be improved. “They not only listened to me, they truly wanted my input,” she says about the Information Technology and Healthcare Innovation team she met with during her visit. [Learn more about our Healthcare Innovation team.](#)

Working with patients to advance our technology, we see great promise in wearable and implanted devices. While many are already smart, connected, and controlled by patient input, we expect AI will help them to automatically adapt and anticipate patient needs in the future and provide a new approach to chronic pain management. This could significantly reduce the need for prescription painkillers among certain patient populations — reducing hospital admissions due to overdose, and helping address a nationwide opioid crisis that currently costs the U.S. \$78.5 billion per year.⁸

Advanced design continues to enhance safety, quality, and durability of products. We already see significant progress in this space, with Medtronic minimally invasive tools that help surgeons with early detection and more targeted treatment of conditions like lung cancer and Barrett’s esophagus, a leading predictor of esophageal cancer.

U.S. opioid crisis costs \$78.5 billion per year⁸

“The recovery was one of the simplest things I had to go through, considering the gravity of the situation. If the doctors hadn’t found the cancer so early, I don’t know what would have happened.”

“The recovery was one of the simplest things I had to go through, considering the gravity of the situation,” says lung cancer survivor Jackie Marino, who had her disease diagnosed and treated with the help of Medtronic surgical technology. “I was able to get back to my family and my life so quickly and haven’t had to go through another treatment since the surgery. If the doctors hadn’t found the cancer so early, I don’t know what would have happened,” she adds. [Read Jackie’s Story.](#)

Innovation in the surgical space continues, and in the future we believe more surgical procedures will be facilitated by robotic, navigational or automated technologies. Research by Cambridge Medical Robotics suggests robotic surgery will grow to five times its present scale by 2025.⁹ As more

5X
Robotic surgery will grow 5 times by 2025⁹

procedures become facilitated by this kind of technology, we see great potential across the care continuum for patients, and intend to be a leader in advancing computer-assisted minimally invasive procedures well into the future.

REAL WORLD APPLICATION HELPS EXPAND INNOVATION

Our partners at universities, hospitals, and healthcare startups help us combine a patient-centric mindset with rigorous clinical trials required to expand our impact. In 2016, Medtronic acquired HeartWare™, a startup that developed a left ventricular assist device (LVAD) to help those with advanced heart failure awaiting a transplant. Working with researchers at Duke University and University of Michigan, Medtronic has since received FDA approval for expanded use of the device to serve as a destination — or permanent — therapy for patients who may not be eligible for a transplant.¹⁰ [Read the story.](#)

Our growing global network of innovation centers — from Brazil to China — provides critical insight to the nuances that exist in healthcare delivery from one region to another. What patients and providers in India need, for example, may be different from what is needed in the Netherlands. Even within a single region, needs can vary. Our newest center, in Chengdu China, is strategically located to serve the needs of Central and Western China. Compared to more developed countries, the region lacks sufficient clinical training for healthcare professionals, with less than half the number of on-the-job medical training organizations compared to the eastern parts of the country.¹¹

When we cannot physically be in a healthcare setting to experience what challenges exist, we rely on technology to bridge the gap. At our Applied Innovation Lab in Minnesota, a 360-degree “holodeck” video screen provides an immersive experience that helps scientists and engineers understand the needs of healthcare providers in remote regions and identify root causes of barriers to care. Such technology played a key role during a 2016 pilot program in Ghana and Kenya that addressed a high prevalence of hypertension in the region. The pilot has since led to the creation of Medtronic Labs Empower Health™, a novel hypertension management model intended to reduce the burden and improve the efficiency of managing hypertension for both patients and clinicians in emerging geographies.¹²

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DATA AND EXPERTISE UNCOVER POTENTIAL

The massive amount of data collected by today’s wearable and implanted medical devices provides insight to the healthcare realities of the future. Announced in late 2017, a new partnership between Medtronic and Mercy Health established a data sharing and analysis network that will help record clinical evidence — using anonymous patient data from implantable devices — to further medical device innovation and patient access to care. The partnership combines Medtronic knowledge of medical technology with Mercy’s expertise in integrating data analytics to care delivery.¹³

Medtronic frequently collaborates with scientific experts to gain deeper understanding of the complexities behind chronic diseases. “Medtronic brings our expertise in biomedical, electrical, and mechanical engineering together with scientists from fields such as neuroscience, cardiology, and urology,” says Dwight Nelson, a chief scientist at Medtronic and expert on stimulation of the nervous system. “Diseases are not confined to a single body system, and modern therapies cross these artificial boundaries. When teams can reflect this diversity, we’re able to gather the data needed to drive new therapies.”

“Understanding the large-scale shifts taking place in healthcare today helps us identify where the greatest opportunities exist.”

Recognizing where we and our partners can have the greatest impact is also key to driving progress. “Understanding the large-scale shifts taking place in healthcare today helps us identify where the greatest opportunities exist,” says Medtronic scientist Nathalie Virag. “When we combine those opportunities with our shared areas of expertise, we can make a real difference for the patients and providers we serve.”

INNOVATION HAPPENS BEST WHEN IT HAPPENS FAST

“The amount of knowledge that we’re exposed to now essentially doubles every year,” explains Hill. “Innovation comes from identifying ways to use that knowledge to create new technologies and solutions that provide meaningful value to our patients. Accelerating innovation through collaboration and partnerships helps improve our ability to deliver on the Mission.”

Backed by teams of experts spanning disciplines and cultures, Medtronic creates forums intended to accelerate R&D. Internally, the company’s Knowledge

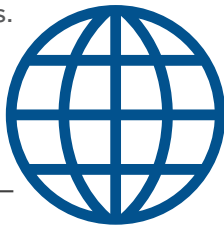
Center team built a communications infrastructure for technical experts across the organization. Internal scientific conferences and symposiums facilitate critical in-person teamwork, while supplemental online platforms like MIX (Medtronic Information Exchange) fill the gaps.

In one year, more than 2,000 questions were posted to the company-wide online collaboration tool, and our experts generated nearly 6,000 responses.

A PROMISING FUTURE OF BETTER HEALTH

For patients like Ron, Donna, Jackie, and Tia — and the people who care for them — Medtronic is already making a difference.

But there is still tremendous opportunity ahead. We envision a day in the near future when capabilities like 3D printing will allow physicians to order customized devices manufactured for specific patients; and training on the latest surgical procedures will happen using augmented reality.



“The opportunity to really change healthcare for patients is going to be completely evolved in the future. We intend to be leaders in that evolution.”

Longer term, with the help of our partners, we anticipate a day when chronic disease management becomes effortless for patients, cancer treatment is nothing more than a day procedure, and debilitating heart and brain conditions are not only more treatable, but entirely preventable.

“The opportunity to really change healthcare for patients is going to be completely evolved in the future,” says Hill.

“We intend to be leaders in that evolution.”

For the millions of patients we serve, the future starts today. We invite you to share in the possibilities, and help us take healthcare Further, Together.

Learn more about innovation at Medtronic.ca

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