THE MAGIC TOUCH

Randy Marsden
is on a mission to
make a dirty world
a safer place

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"The problem with bacteria is you can't see it," says Randy Marsden, who has invented a technology that makes it harder for deadly bacteria to lurk in hospital rooms. He hopes to make a dent in hospital-acquired infections, a leading cause of death in North America.

by SARAH LIGON | photos by JOHN ULAN

The Keys to Life

WHY RANDY MARSDEN IS THE MOST IMPORTANT INVENTOR YOU'VE NEVER HEARD OF

On February 5, 2012, **Gil Allan,** '82 BEd, visited his father in the recovery ward of an Edmonton hospital. Allan was relieved to see his dad, Bud Dahlseide, looking in such good colour and spirits after a month-long hospital stay to remove the defibrillator in his chest and replace it with a pacemaker. They went down to the food court for ice cream, where Dahlseide joked with the staff. "Everyone's expectation was that he was fine and real soon would be going home," remembers Allan. "But when I was putting him to bed, he said, 'You know, I feel funny. I feel like I have the flu coming on.'"

Somewhere in the hospital's corridors, Dahlseide had come into contact with *Clostridium difficile*, or *C. difficile,* one of the strains of antibiotic-resistant bacteria known as "superbugs." Once the bacteria entered Dahlseide's body, they found their way to his colon, multiplying and releasing toxins that caused severe diarrhea and bloating. Within four days, his kidneys had shut down. "On Feb. 5, he was my dad, he was completely himself," remembers Allan. "Four days later he was dead."

What happened to Bud Dahlseide is tragic but increasingly common. Hospital-acquired infections, including *C. difficile,* are the No. 4 cause of death in North America, behind cancer, heart disease and stroke. Every year, more than 220,000 Canadians will acquire an infection while in hospital, and at least 8,000 of them will die. The numbers are even more staggering in the United States, where 1.7 million people will become infected and nearly 99,000 will die.

"JUST IMAGINE IF WE PUT THE SAME ENERGY, PASSION, MONEY AND ATTENTION INTO LOOKING AT THE HARD PROBLEMS IN OUR SOCIETY, INSTEAD OF WHAT'S THE NEXT BIG FACEBOOK." — RANDY MARSDEN

"That is the equivalent to the audience at this year's Super Bowl—and that many will die every year," says **Randy Marsden,** '89 BSc(ElecEng), an Edmonton entrepreneur who is working to drastically lower that figure. "It should be completely preventable."

Marsden is one of the rare individuals who can claim "inventor" as his occupation. He is in his late 40s, with a thick build, thin-frame glasses and a neatly trimmed beard. His well-kempt appearance belies the popular image of the dishevelled, eccentric genius. It is easier to imagine him the clean-cut Mormon kid from southern Alberta who, at 19, undertook a two-year mission to Japan and became fluent in the language.

Even today, 25 years later, he is as full of certitude as any proselytizer, but his mission now is to save lives by preventing hospital-acquired infections. His target is the keyboard on which this story was typed.

TECHNOLOGY THAT MATTERS

When you think about it, a computer keyboard really is impossible to clean. There are at least 60 keys, and well over 100 on some keyboards, on which harmful bacteria can rest, and each key has four exposed sides down which liquid and debris can creep and fester. In addition, depending on the model, there are any number of cords, ports and screws that can harbour harmful bacteria.

A 2012 study by the University of Calgary and The Ward of the 21st Century monitored the presence of harmful bacteria, including *C. difficile*, on hundreds of keyboards in five different hospital settings, and the results were surprising. Where previous studies had shown that hospital ventilators and infusion pumps were one per cent contaminated and faucets were 11 per cent contaminated, the 2012 study showed that the most-contaminated surfaces, at 58 per cent, were computer keyboards.

It turns out that keyboards are something Marsden knows a lot about.

Marsden is the creator of Swype, a text-input technology for smartphones, which he sold for $102.5 million in 2011 to Nuance, a Boston company responsible for the voice-recognition technology behind the iPhone's Siri. His innovation was designing a flat-panelled keyboard surface where, instead of tapping out individual letters, you rest your finger on the first letter, then slide it from letter to letter to form a word.

What found commercial success as a software add-on that enables faster texting—now installed over 200 million times—actually began as an assistive technology Marsden developed for the disabled, particularly those with limited or no use of their hands. In one way or another, he has been developing keyboards that improve lives since he was an undergrad at the University of Alberta.

Back in 1987, Marsden's third-year engineering class was assigned a semester project. "They gave us a couple of choices," he remembers. "They had these wheels that spun around, and you could make a circuit that counted how many times it turned around. Or you could make up your own thing. Well, I made up my own thing."

Working with lab partner **Michael Tanne,** '89 BSc(ElecEng), Marsden set out to create a keyboard to help a family friend communicate after a paralyzing accident.

Si Peterson was just 16 when he fell from a gymnastics high bar, severing his spinal cord in three places at the first vertebra. By the time Marsden began working with him, Peterson had been confined to a bed for more than a decade, unable to move below his chin, breath on his own, or even speak.

In less than a semester, Marsden and Tanne created an early version of a laptop that allowed Peterson to use his lip to touch a switch that would scroll through a list of about 100 phrases, which would then be "spoken" using digitized speech. The technology allowed him to communicate and, later, to control his surroundings.

Marsden and Tanne's invention was so ahead of the curve it placed second in the Canadian Engineering Competition that year, beating out nearly 150 other entries. (The next year, Marsden notes, he placed first with another project.) It also won them another distinction. Just before graduation, Sym Systems, a Silicon Valley company that specialized in assistive technology, flew the lab partners down to California to interview—along with several other candidates—for a single position. "They saw our student project, and by the end of the weekend they had offered us both jobs," remembers Marsden.

Tanne took the job, and later got an MBA from Stanford. He is now an entrepreneur and investor working with early-stage technology companies in Silicon Valley. But Marsden decided to stay in Edmonton and start his own company, Madentec. "I knew I'd found what I wanted to do," he says.

In the past 25 years, Marsden has headed up companies that develop and commercialize his inventions, primarily assistive technologies that have allowed people, including Muhammad Ali and the late Christopher Reeve, to access computers. "Once they had access to a computer, we opened up the world to them," says Marsden. "Vocation, education, socialization,

communication—you don't know if the person on the other side of that computer sending you emails has a disability. It just removes the disability."

Assistive technologies aren't beneficial only for people who are disabled. Consider, for example, the number of able-bodied people who use a building's automatic doors rather than the manual ones or who use the curb cuts on a sidewalk for their baby strollers or bicycles. "They say closed captioning is seen by more people in bars than by deaf people," says Marsden. "If a technology makes life easier for a person with a disability, it makes life easier for everyone else."

THE BIRTH OF INVENTION

The Canadian journalist Malcolm Gladwell, who frequently writes about innovation, once hypothesized that the requirements for a successful invention were "genius, obsession, serendipity, and epiphany in some unknowable combination." Marsden would certainly seem to conform to that formula. He believes inventors are "born not made," and he remembers as a child how it worried his mother that he was always destroying his toys. "It was because I wanted to see how it worked," he says, "and sometimes that meant destroying it."

When his parents started buying him Lego, Marsden stopped destroying his toys and started building them, instead. To this day he still enjoys Lego and recently helped his own 10-year-old son, the youngest of his five children, design a "black hole" using a plastic garbage bag and Lego Mindstorm, a series of the popular toy line that includes both the small, plastic building blocks and computer software for creating programmable robots.

"I actually ask every engineer I interview if they played with Lego as a kid," explains Marsden, "because the true engineers always say, 'Yeah.' They want to build stuff, to solve a problem, to stop that door from squeaking."

Clearly, Marsden was born with that need to tinker, but with his recent innovations in text input, he is taking invention a step further. "Text input

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5   ASSISTIVE TECHNOLOGIES YOU USED TODAY

It's often the case that something originally designed to help people with disabilities winds up helping everyone. Technology-based innovations for the disabled that have been universally adopted are often called "electronic curb cuts." Here are some that you probably used today:

Closed Captioning

ORIGINAL USE
Translation of sounds on TV for the deaf or hard-of-hearing

MAINSTREAM USE
TV screens in bars, airports and gyms where everyone has a hard time hearing

Computer Keyboard Equivalents

ORIGINAL USE
Controlling menu items on a computer for those unable to use a mouse or see the screen

MAINSTREAM USE
Anyone wanting to save time with computer shortcuts (control "s" to save, for example)

Digitized Speech

ORIGINAL USE
Computer-generated speech allowing those unable to speak with their own voice to communicate (think Stephen Hawking or patients who have had laryngectomies)

MAINSTREAM USE
Voice prompt telephone systems, those often-annoying menus when you call a customer-service hotline

Word Prediction

ORIGINAL USE
Speedy text entry for people unable to use their hands to type

MAINSTREAM USE
Now used almost everywhere (especially in cellphones) for speedier texting

Onscreen Keyboards

ORIGINAL USE
Entering text for those unable to use their hands to type on a traditional keypad

MAINSTREAM USE
Most tablets, smartphones and PDAs now use onscreen keyboards for entering text

is the future of the computing world we're going to be living in for the next 50 years," he says.

It's a world in which we are, despite our increased reliance on gadgets, a lot less device-centric. The days of everyone carting around a personal laptop are over. Computers are built into nearly

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everything in our environment—our cars, our phones, check-out lines—and they all require you to input text onto surfaces.

Marsden is currently developing technology that enables a user to more easily enter text on tablets. Users can set down their fingers anywhere on the surface, and a keyboard forms around their fingers. Then they begin typing.

"I'm an inventor," he says. "I get excited about creation. Once it's invented, there's a whole lot of work to do to get it done: business development, commercialization, marketing and sales. I don't enjoy that stuff as much as inventing, so I hire people who are good at those things. What I think about in my spare time is always the next invention."

MAKING THE IMPOSSIBLE POSSIBLE
The offices of Cleankeys, Inc., are about as far away in size and scope as they are in distance from the giants of Silicon Valley. They are housed in a nondescript, two-storey industrial park building in South Edmonton, in between a stainless-steel wholesaler and a company that builds custom cabinets.

Inside, on the taupe walls of the conference room, are awards Marsden's inventions have won over the years: a 2008 Alberta Science and Technology's

Social Impact Award, a 2011 Manning Innovation Award. In central place of honour is a certificate from the Guinness Book of World Records given to Hank Torres in 2011 for "fastest hands-free typing." Torres, paralyzed from the neck down, earned the record using Marsden's TrackerPro—a head-tracking device that allows users to control a mouse pointer by puffing through a thin straw attached to a computer loaded with Swype technology.

Interestingly, it was that very same model of TrackerPro that led Marsden on the path to creating Cleankeys and a solution for hospital-acquired infection.

In 2007, Marsden saw an order through his company for the head-tracker from a dentist in France. Since, he figured, the dentist was not practising hands-free dentistry, he emailed to ask why he wanted the device. It turns out the dentist had just invested in a digital X-ray system for his treatment room, but every time he touched the mouse and keyboard he had to change his gloves. The French dentist had discovered he could avoid that trouble by attaching one of TrackerPro's reflective stickers to the back of his hand-held dental mirror and waving it through the air to move the computer's cursor.

At first Marsden thought he might have a new market for his head-tracking device: dentists. But a dental focus group in Edmonton was less than enthusiastic. "They said, 'This is a $1,000 mouse, and we can probably just wipe down the mouse between patients.' " But as they were leaving,

Marsden had a thought: "You say you can wipe down the mouse, but what do you do about the keyboard?"

"And they said, 'Oh, well, the keyboard is impossible to wipe, so we have to wrap it in Saran Wrap. Now, if you can come up with a better way to clean a keyboard ... then that's something we can all use,' " recalls Marsden.

Six years later, on the factory floor at the back of Cleankeys offices, a pair of employees is assembling dozens of keyboards that have no keys, no screws, no openings at all—only two flat acrylic panels attached with adhesive. One version of the keyboard and its mouse operates on wireless technology, so there are no cords, either. It is completely wipeable, front and back. In fact, you could dunk it in a bucket of water because it's completely waterproof, too.

Since launching commercially in February 2011, Cleankeys has sold about 20,000 keyboards to dentists (at $399 each) and has more or less solved the problem of the cleanable keyboard. Now, Marsden has set his sights on getting them into the hands of doctors.

TYPING, SWYPING AND WIPING
In more than 90 published studies, researchers have found that handwashing compliance in a normal hospital setting is only about 40 per cent. That jumps to 90 per cent when health-care workers know they are being monitored.

Marsden and his team have developed software that can automatically detect when one of his keyboards has been cleaned, how well it has been cleaned, with what and by whom—and he did it using the same ideas that led to Swype.

It has to do with the capacitance of touch surfaces. All surfaces have an electric field, which becomes disrupted and changes when it comes in contact with other things—fingers or liquids, for instance. By measuring changes in the electric field, the sensors in his technology can distinguish between when you're just setting your fingers

down on a touch-sensitive keyboard and when you begin typing. "Well, we figured out that the same sensors that we were using to detect typing can also detect wiping," says Marsden.

The software runs on a computer's dashboard and lets the user know when it's time to clean. "The problem with bacteria is that you can't see it," says Marsden. "So we simulate it. Then as you wipe, it starts to clean those grey areas, and if you miss a corner you can see it on screen. And it won't allow you to reset the clean-meter until you've reached 100 per cent coverage of the surface." If you try to cheat, by just wiping it with your hand, it won't work.

Marsden's software pushes the data for each keyboard up into the "cloud," where a hospital administrator can monitor all keyboards in a hospital at any given time and issue warnings—directly through the computer—that it's time for a particular workstation to be cleaned. And the application of this software doesn't just stop at keyboards. It can be adapted to monitor mopping the floor, wiping down countertops, changing bed linens, even the Holy Grail of compliance: employee handwashing.

Currently, prevention activities in hospitals are mostly of the pen and paper variety. An administrator might find out a week or two later that a room or workstation wasn't cleaned properly. But by then, the damage would have been done.

Gil Allan believes that his father contracted the infection that killed him because hospital staff weren't following protocols. Across the hall from his father's room was an isolation room, where everyone entering and leaving was supposed to wear gloves and booties. "What struck me," says Allan, "was that I saw hospital staff going in and out of that room without following the protocols they made visitors from off the street observe."

"If we can monitor prevention activities in real time to get their compliance up," says Marsden, "that should put a real dent in the spread of infection." ∎

'Who Are You Going to Help Next?'

Although his inventions have been hugely successful, Randy Marsden has struggled to base his companies in Edmonton. Despite the wealth in the province, Alberta is primarily an oil- and agri-based economy, and local investors are wary of venturing into new territory.

"THE REASON SILICON VALLEY IS so successful is the people who are investing there made their money in technology; they understand it," he explains. "I remember pitching to one investor, and he said to me in the end, 'You know, Randy, I completely believe you that *you* understand what you're talking about, but I don't have a clue what you're talking about or how you're going to do it competitively."

Ultimately, he had to move Swype to Seattle, Wash., to see it through the "Valley of Death," the hazardous terrain between R&D and commercialization, when government research grants have dried up but before venture capitalists are ready to jump on-board. However, this time he's committed to keeping Cleankeys in Edmonton, although it took 125 different pitches to 85 individuals before he found a single angel investor.

At the moment, Edmonton is seeing a burst of energy in the technology and entrepreneurial sector. Two organizations have launched in recent years to accelerate local innovation and turn Edmonton into the Silicon Valley of the Prairies: TEC Edmonton, which helps spin off U of A research projects into commercial ventures, and Start-Up Edmonton, founded by **Ken Bautista,** '99 BEd, which offers similar support for the creative class. Now, Marsden is serving as board chair of a third, Technology Alberta, an association of locally based technology companies, founded in 2012, trying to affect government policy to make the local environment more fertile for tech start-ups.

"It's possible to have a home-run technology company in Alberta," he says, citing the $5 billion in successful technology companies that have come out of the province in the past 10 years. They include: Zedi; BioWare, founded by **Ray Muzyka,** '90 BSc(Med), '92 MD, **Greg Zeschuk,** '90 BSc(Med), '92 MD, and **Augustine Yip,** '90 BSc(Med), '92 MD; Wintax, founded by **Bruce Johnson,** '83 BSc, and **Chad Frederick,** '78 BCom; and Axia, whose CEO is **Arthur Price,** '73 BSc(MechEng).

Still, Marsden admits that he might have been more successful had he headed south after graduation. But he always hears a voice in the back of his head reminding him that inventing new technologies should be about more than creating the next Facebook or Twitter or YouTube.

"Si [Peterson] changed my life with one question," said Marsden, in a TEDx talk he gave on "engineering for the social good" in Edmonton last July. "After he tried our stuff, he turned to me and said, 'Who are you going to help next?'

"If those big companies started thinking about the bigger social issues and put their resources behind it, imagine what's possible," he mused later. "I have no doubt that Apple could knock out hospital-acquired infections if they put their money behind it. Instead, we're sitting here as this little 15-person company.... It may sound dramatic, but we really can save lives with a computer keyboard."