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The MacGyver Cure for Cancer

By BONNIE ROCHMAN MAY 23, 2014

Two decades ago, David Walmer went on a volunteer mission with his church to Haiti. He was sent to paint walls at a hospital in the seaside town of Léogâne, but when the people there learned that Walmer was a doctor — he was a fertility specialist at Duke University — they asked him to spend the week with a local obstetrician-gynecologist named Jean-Claude Fertilien. Walmer was shocked by what he saw: Fertilien finishing a hysterectomy with the aid of a flashlight when the hospital generator failed to restart, for instance, or when an anesthesiologist wasn't available for an emergency C-section, the doctor just numbing the skin and cutting. At one point, Walmer was called to the bedside of a young woman in her mid-20s with undiagnosed cervical cancer who had gone into septic shock. There was nothing to be done for her, and she died right in front of him. Walmer was appalled. In the United States, cervical cancer is considered a preventable disease.

“You have 10 years to detect this disease before it becomes untreatable,” Walmer says. “And it’s easy to detect. It develops on the outside of the cervix, which you can see.”

At the end of his week in Haiti, Walmer, who is a boyish 61, put a question to Fertilien: “I’m a busy guy. But if there’s one little thing I can help you out with, what would it be?”

“Cervical cancer,” Fertilien said.

Walmer had no expertise with the disease — he divided his time between seeing patients and doing lab work, analyzing the biology of the

uterine lining — but he told Fertilien he would do his best.

Back at Duke, he pressed colleagues to let him work alongside them and learn about the disease. He knew that an effective screening program would be the biggest single fix he could propose. In the U.S., screening is typically done with Pap smears — a quick swab of a woman's cervix to screen for the cellular changes that foreshadow cancer. If abnormal cells are found, a doctor will usually perform a colposcopy, in which the cervix is examined using a specialized magnifying lens, a colposcope, to see if disease is visible. Before the widespread adoption of Pap smears in the 1950s and '60s, cervical cancer was the top cancer killer among women in the U.S. Now, when caught in time, the diagnosis and treatment are pretty straightforward: Paint the cervix with acetic acid — essentially vinegar — which turns abnormal areas white. Confirm the presence of disease with a biopsy. Then freeze or remove the abnormal cells.

Thanks to early detection (and helped by the vaccine for HPV, or human papillomavirus), the mortality rate for cervical cancer in the U.S. is relatively low. Not so in developing countries, where it kills almost 250,000 women every year. Haiti has one of the highest rates of cervical cancer in the world. Walmer knew that a national screening program would save countless lives, but deploying colposcopes across the impoverished nation was not feasible. They're expensive, they require reliable electricity and they're too big to be easily carted around to the ramshackle clinics throughout the country. A battery-powered, portable and affordable alternative was needed.

At the time, in the mid-1990s, Walmer was teaching young doctors how to reverse sterilization surgeries by repairing women's fallopian tubes. He used loupes, or surgical glasses, to see the tubes properly. "I realized, I've got these magnifying lenses right here, and they don't require any electricity," Walmer says. A solution began to take shape in his mind. He bought a halogen headlamp at a bike shop and a green filter at a camera store. He figured that by switching back and forth between green and white light he would be able to provide the contrast needed to identify

precancerous lesions on the cervix and the pattern of blood vessels that indicate something suspicious.

Even as he kept tinkering on his portable, primitive colposcope — the light wasn't properly aligned, for starters — he traveled to Haiti several times a year, his suitcase stuffed with donated surgical gloves, slides and stains and brushes to do Pap smears. “I really felt a calling,” Walmer says. What others might find discouraging — doctoring in the most downtrodden conditions — he found exhilarating. “I was having more fun helping the Haitians than I was at my real job,” he recalls. “You could operate and save a woman's life, and every time you came back to Haiti, she would come to the clinic and hug you and introduce you to her family members.”

By 1997, he told his boss he was closing his lab, effectively putting an end to a nearly two-decade-long academic career in biochemistry. He started traveling to Haiti more often and joined the boards of nonprofits that were active there. The urgency of his previous work paled in comparison. “If people are dying of a treatable disease,” Walmer says, “how important is understanding the biochemistry of the uterine lining right now?” He was convinced that developing a realistic way to screen Haitian women for cervical cancer was the key to keeping his promise to Fertilien, so he continued to putter with his rudimentary colposcope.

“It was pretty crude,” he says. “Most people thought it wasn't likely to work, but it was very Haitian, where people solve problems in creative ways.”

Word of what Walmer was trying to do eventually reached Bob Malkin, a Duke professor of biomedical engineering who develops medical instruments for third-world hospitals and clinics. (He teaches a course at Duke called Design for the Developing World.) The field is a small one. “When I started in 2001, it was a group of one — and that was me,” he says. But it has grown: In addition to Duke, the University of Michigan, M.I.T., Rice University and others have begun adapting sophisticated medical equipment to address common diseases like asthma and diabetes

in poor countries. In 2012, Malkin's invention, the Pratt Pouch — it looks like a fast-food ketchup packet but contains antiretroviral medication to help prevent pregnant mothers from infecting their newborns with H.I.V. — was named one of the top 10 “innovative health technologies for low-resource settings” by the World Health Organization.

In 2001, when Malkin was a professor at the University of Memphis, he co-founded Engineering World Health, a college club that would eventually expand to dozens of campuses — including Duke, after Malkin joined the faculty there in 2004 — and evolve into a nonprofit company whose focus was improving hospital conditions in developing nations. Every summer, the nonprofit dispatches students in physics, chemistry and engineering to places around the world to fix old medical equipment, set up donated supplies and teach health practitioners how to use them. Malkin also started the Competition for Underserved Resource-Poor Economies (CUREs), which awarded as much as \$100,000 to a student-generated business plan for a nonprofit that addressed a medical need in impoverished countries.

Malkin was intrigued when he heard about Walmer's device. Maybe, he thought, his students could help turn it into a usable tool. “He already had a solution,” Malkin says of Walmer, “but it wasn't working well.”

The problem was that the device was uncomfortable: It put too much weight on the nose. “We had a working model, but it was too heavy,” Walmer says. “We were dead in the water.” Walmer had become so frustrated that he put the project aside. Malkin suggested that his students might provide fresh eyes, and Walmer agreed. He invited a group of five students to his office to tell them what he had done so far. Recently, for example, his engineering colleague had attached the lights to the end of the lenses, but that hadn't worked. “We need to move everything back to the forehead, which goes back to the concept of what we first had with the bike-light headband,” Walmer told them. The students were game.

“They realized we'd been through lots of renditions, and they realized they were coming in after degree, Duke University engineers who had

volunteered their time,” Walmer says. “They were all pretty excited. They thought, We are solving a real-world problem.”

One of them, Theo Tam, first learned about Duke’s Engineering World Health club online. It inspired him to leave California, where he worked as a space-systems engineer, and to enroll at Duke, where, in addition to pursuing his master’s in engineering management, he was selected as a CUREs fellow — one of seven students who would immerse themselves in tech entrepreneurship.

In September 2006, Tam, then 24, approached four students in his master’s program to work on the portable colposcope. None of them wanted to touch the project. All four were men, from China, India and Pakistan, and they were squeamish about anything that involved women’s anatomy. They proposed alternate challenges: a malaria microscope, an oxygen flow meter. “Anything but the V-word,” Tam says. “Imagine the horror.”

“Guys,” Tam told them, “it’s not as bad as you think.” Then he sold them on the aspects of the project that weren’t related to gynecology. One student volunteered to focus on marketing, another on finance. Tam took on the clinical research himself.

The first task was to settle on a name for the device, something catchy and descriptive but not too cutesy — they chose “CerviScope.” Next they sketched out a business plan. “Ending cervical cancer,” they wrote during a brainstorming session. Then, “How?”

They began by reaching out to gynecologists around the globe who had expressed interest in Walmer’s invention after he posted news of it online. In Pakistan, doctors wanted more distance between device and patient, to avoid getting too close and making the woman uncomfortable. In Singapore, doctors requested less distance, to make training students easier. Some doctors wanted a device mounted on a headband; others preferred a helmet or glasses. Some wanted a fixed light; others liked the idea of an adjustable gooseneck. Ultimately, the team decided to accommodate the doctors in Haiti, who wanted the weight on their

forehead, not pushing on their nose. But in March 2007, when Tam took a prototype to Haiti and gave it to a doctor there, the doctor tried it on, complained that he couldn't see well enough and took it off.

Tam was also trying to keep the whole thing inexpensive. He increased the magnification to 8x by taking the lenses from a \$10 set of binoculars bought at Walmart. A pair of \$16 battery-powered LEDs provided the light. The adjustable headband that fitted above the ears was tweaked. In April 2007, the students won the CUREs competition, beating six other teams of undergraduates, grad students and even physicians. Suddenly they had \$100,000 in prize money. They hired an engineering firm called Applied Technologies in Cary, N.C., not far from Duke, to refine the device so it could be mass-produced.

The first step was to reorient the lenses. Surgical loupes are custom-designed for each physician. "A rep comes to measure the distance between my eyes because different people's eyes are different distances apart," Walmer says. "But if we are going to do this globally, we can't manufacture each one personally. So we asked them to build a slot so you could move the lenses back and forth, right and left, until they'd line up with whoever's eyes were looking through the devices," Walmer says.

Then one of the firm's engineers cannibalized the lenses from a \$2 pair of reading glasses and incorporated them with a pair of binoculars. "There was nothing on the market that gave us the magnification but also focused up close," said Dan Fucella, the firm's head. The combination worked: Reading glasses are designed for close viewing, binoculars to magnify objects at a distance, allowing a user to quickly switch perspectives, the better to see cervical changes. Walmer was thrilled as the device approached completion. He regularly tested the latest iteration of his scope on patients. "I love taking a problem, problem solving and bringing together people who can go back and forth over time to solve that problem," Walmer says. "Working in Haiti is a slow, steady process, so this matched up with it."

Finally, at the beginning of September 2009, 13 years after

Walmer put together his first makeshift gadget, 10 field-test models were ready. They weren't much more than black metal tubes and lights and wiring, but Walmer says he didn't stop smiling for a week. One scope was shipped to Malawi, another to Argentina and a third was earmarked for Kenya once doctors there were trained in colposcopy; it would go to a clinic for women in Masai villages, where polygamy increases the risk of cervical cancer. Others landed in Pakistan and, hand-delivered by Walmer, in Haiti.

One final problem existed. It was taking about nine hours to machine the parts and assemble a single unit, and it cost more than \$1,000, which was too expensive to be scalable. Help came from Goldman Sachs in Singapore, where one of the student engineers, Gauravjit Singh, went to work after graduating from Duke. Together he and Walmer submitted a grant proposal to the investment bank, which agreed to finance the manufacture of injection molds needed to mass-produce the scopes.

Walmer's own nonprofit, Family Health Ministries, which he started in 2000 after he began receiving donations for his work in Haiti, will be selling the CerviScopes at cost to health care providers in poor countries. (The goal is to price them under \$750.) Walmer and his wife, Kathy, initially set up the outfit in their sunroom, with little more than a dedicated phone line. "We told the kids, 'When this phone rings, you be quiet.' We'd answer, 'Family Health Ministries.' We always pretended to be bigger than we were, and we grew into it." In the past five years, Walmer says, the nonprofit has raised \$6 million. In 2012, the production of the first 200 scopes began. They are now sitting in Walmer's office while he figures out where they will go. It seems to make sense to roll them out, at least initially, in a country where the regulations and the bureaucracy are familiar, a place like Haiti.

The CerviScope is not the only Family Health Ministries project. The group is about to break ground for a surgical wing of a teaching-and-research health center and a birthing center in Haiti, where doctors from the U.S. can work beside their local counterparts. And Walmer is

continuing to work on a national cervical-screening program. Even if Pap smears were widely available, they wouldn't stem the tide of disease; many women in Haiti have underlying inflammation that makes diagnosis tricky. In any case, there aren't enough doctors to interpret the test results. "There are only nine pathologists in the whole country, so there's no one to read Pap smears," says Walmer, who went into private practice in 2012, giving him more time to travel to Haiti. "When we first started doing them, we shipped them to the States."

Walmer advocates testing for HPV, which causes most cases of cervical cancer. As the cost of HPV testing drops, it's a strategy that is finding favor as a first-line approach to detecting and preventing cervical cancer in the developing world. His nonprofit has set up an HPV lab in Haiti to process the tests. In June, Walmer is taking part in a Haitian Ministry of Health workshop whose focus is revising the country's standards for cervical screening. "They have decided this is a priority," says Walmer, who is in talks with the ministry about using the CerviScopes there.

Mother's Day in Haiti is approaching — it's always the last Sunday in May — and some women traditionally wear flowers that day: red if your mother is living, white or purple if she's not. This year, Family Health Ministries wants to establish a new Mother's Day tradition: cervical screening.

"Life has a way of detouring," Walmer says. "Preventing cervical cancer was never my plan. And yet I think this was better than the plan I ever had for my own life."

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