Customer Stories:

WaveGuide

WaveGuide's connected health device makes waves: Breakthrough technology delivers rapid results to help prevent pandemics

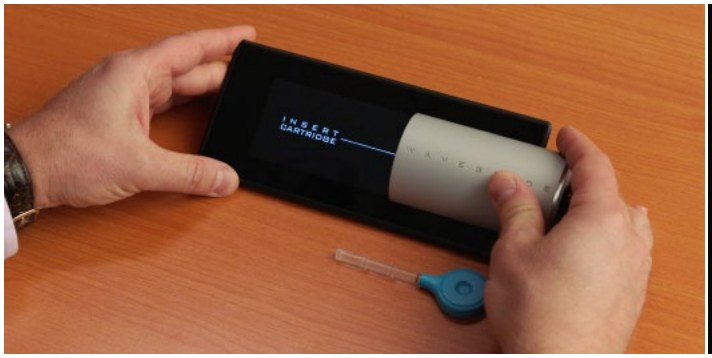
- **Business needs** - Better ways to diagnose patients and alert public health officials of impending disease outbreaks
- **Networking solution** - Equipping hand-held micro-nuclear magnetic resonance devices with AT&T Global SIM cards facilitates medical data transmission in near real-time
- **Business value** - Early diagnosis and intervention helps improve patient outcomes, reduces costs, and could help prevent outbreaks from becoming pandemics
- **Industry focus** - Medical and industrial detection
- **Size** - Startup

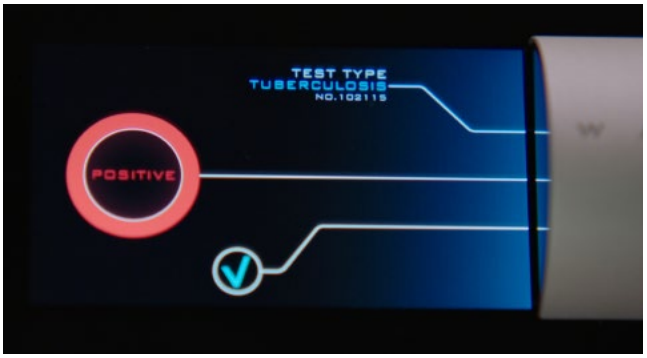
About WaveGuide Corporation

WaveGuide, a Delaware corporation based in Cambridge, Massachusetts, researches and develops hand-held micro-nuclear magnetic resonance platform technology. WaveGuide combines proprietary molecular spectroscopy and diagnostic techniques to provide a system to allow diagnosis and analysis, even in remote settings, thereby helping to reduce costs and improve responsiveness to critical patient needs.

The situation

Officials at WaveGuide knew the company's breakthrough technology could be used to help diagnose patients in developing countries, where people had little or no access to medical care. They understood that recognizing patterns of a disease could help to stop outbreaks. WaveGuide wanted to add connectivity to its micro-nuclear magnetic resonance devices to enable healthcare workers in the field to submit data to its research center, which could identify and report developing trends to help stop the spread of infectious diseases.





The solution

AT&T Global SIM cards and the AT&T Control Center enable WaveGuide's innovative Internet of Things (IoT) devices. With AT&T wireless connectivity, WaveGuide's heath device can enable quicker diagnoses and treatment for patients everywhere, but especially in remote parts of the world. The AT&T Control Center enables WaveGuide to deploy and manage its devices in near real-time, helping to recognize, report, and stop the outbreak of diseases like tuberculosis (TB) from becoming pandemics.

Technology delivers low cost, rapid, point-of-care diagnosis

Nuclear Magnetic Resonance (NMR) technology has been used for decades to analyze and identify materials and to enable physicians to distinguish between normal and cancerous tissue. NMR spectrometers are large, expensive machines, ranging from hundreds of thousands to millions of dollars, and so have been available only at first-world hospitals and universities.

For years, researchers have imagined what could be accomplished if the spectrometers could be made portable and less expensive. WaveGuide Corporation is working to make the possibilities of handheld, affordable NMR technology a reality. The company was founded to commercialize pioneering technology developed by Ph.D. researchers at Harvard University.

WaveGuide's handheld, reusable NMR spectrometer (which is the world's smallest such device in a handheld, battery operated format) gives healthcare professionals the power to provide rapid diagnostic services in their own offices, clinics, and hospitals. The portable device, roughly the size of a shoe, uses NMR and a specific chemistry to determine whether a patient has an infectious disease. It can be calibrated to detect pathogens such as bacteria and viruses, infectious diseases such as tuberculosis, and even some cancers, in less than an hour. This is a significant improvement over the 24- to 48-hour delay with current methodologies.

According to Nelson Stacks, WaveGuide's President and CEO, testing is easy to administer and can be performed by healthcare workers almost anywhere. "With only a small sample from the patient, the healthcare provider has results within minutes," he said. The device is expected to enable low cost, rapid, point-of-care diagnosis of diseases; it can

also support scientific research by providing more affordable chemical analysis.

Bringing the test to the patient

WaveGuide plans to initiate the first clinical trials of its patented, handheld NMR device to test patients for tuberculosis in both the U.S. and China. Even though TB is not a major concern in the United States, it is one of the deadliest infectious diseases in the world. "It affects nearly 10 million people each year, and 1.5 million sufferers die," Stacks said. The World Health Organization says more than 95 percent of TB deaths occur in low- and middle-income countries. "But the disease is curable and its spread can be prevented – if it is caught early enough and treatment is started," Stacks said.

Tuberculosis is caused by bacteria that most often affect the lungs; it is spread from person to person through the air when a victim coughs or sneezes. Someone only needs to inhale a few germs to become infected. Most developing countries test for TB by culturing a patient's sputum sample in a laboratory. This is a slow process, as it can take weeks for the TB bacilli to grow. The process is also inaccurate. Current tests sometimes pick up only 20 percent of the cases and are unable to detect drug-resistant strains of the disease.

Nuclear Magnetic Resonance promises faster and more sensitive tests, but existing NMR diagnostic equipment is prohibitively large, expensive and not configured to be able to test for these types of diseases, which makes it inaccessible to many of the populations at highest risk for TB. WaveGuide's NMR device offers the possibility of giving millions of patients faster and more accurate diagnoses in the field. At the heart of the miniature NMR machine is WaveGuide's patented chipset, together with very small magnets that are a fraction of the size of those found in conventional laboratory equipment.

The user-friendly design means medical staff don't need extensive training to operate the device – they simply insert a single-use cartridge containing the sputum sample, and the machine gives the results in less than an hour. "We can bring the test to the patient, rather than the patient to the test," Stacks said. "Even remote parts of world can have detection for TB and, in time, many other diseases."

Besides testing individual patients, however, WaveGuide wanted to collect and analyze all patients' data to identify patterns and alert the countries' health ministries, to help to stop the spread of diseases. The company needed to enable healthcare workers in the field to send data to WaveGuide researchers who could spot developing trends and alert local health officials to help contain the diseases.

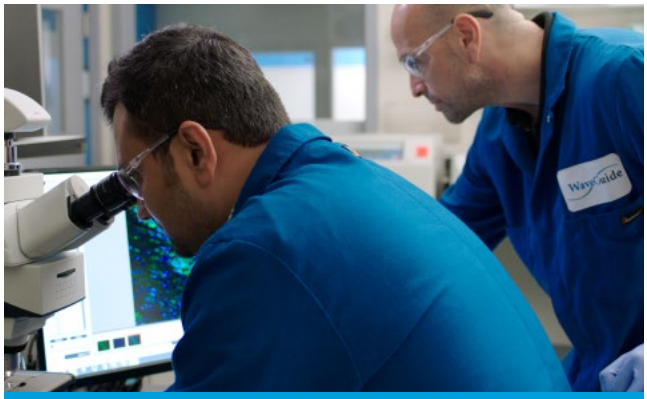
Helping to stop outbreaks from becoming pandemics

Equipping their devices with robust, reliable AT&T connectivity enables WaveGuide to bring about quicker diagnoses and treatment for patients everywhere, but especially in remote parts of the world. "The device does all the work. We use the IoT network to aggregate the data and report back when there are outbreaks of a disease or when there are certain problems," Stacks said. "It will also help us develop even better algorithms for faster detection with even better sensitivity and specificity."

There is another advantage to WaveGuide's NMR device. Stacks said, "The doctors are able to diagnose and treat the disease right on the spot – as opposed to sending patients home, where they can possibly infect others, and asking them to come back in a day or two."

The AT&T Global SIM card gives WaveGuide's devices the power to quickly transmit results to the company's research facilities half a world away. In addition, the AT&T Control Center enables WaveGuide to deploy and manage its connective devices around the world in near-real time. "The AT&T network is critical for us. We use it to upload data via the cloud and do around-the-clock data analytics, looking for trends," Stacks said.

"WaveGuide can then notify public health officials of the precise location of outbreaks within their country."



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> **Nelson Stacks**
> President & CEO, WaveGuide Corporation

he said. "This provides actionable information that can lead to a reduction in the spread of infectious disease. We can be proactive instead of reactive and ensure that sufficient treatment supplies are available."

The solution also provides data that gives WaveGuide better medical and operational insights. "We comply with HIPAA (the Health Insurance Portability and Accountability Act) because we don't have specifics on who the patient is, but we receive data on sex, age, and location," he said. "We can tell if a particular user is administering the test accurately, and we can track whether our cartridges are being bootlegged – for instance, if we sent 20 cartridges but 30 tests were performed."

A shared mission to use IoT for good

Stacks said he was attracted to AT&T because of its international presence and commitment to use the Internet of Things to reduce carbon footprints, eliminate food and water waste, and help make the world safer and healthier. "There are other connectivity vendors out there," he said. "But what made AT&T stand out to us was certainly its global reach and mission to use IoT for good."

Like AT&T, he said, WaveGuide wants to make a difference in the world. "None of us are nonprofits; we want to make money," he said. "But at WaveGuide we also want to do good in the world and help people," he said. "AT&T's IoT for Good program and its work in healthcare were important to us. It was good to find someone that understands our business."

The AT&T account team working with WaveGuide was extremely helpful, Stacks said. "They bought into our

vision. It felt like a partnership to work with someone that is rowing in the same direction as us," he said.

The future of healthcare: better, faster, cheaper

Stacks views medical advancements like WaveGuide's handheld NMR device as the future of healthcare in the digital age. "We see it as better, faster, cheaper – delivering healthcare that's less expensive is great for the patient, as is getting them a quicker diagnosis," he said. "If we can bring the test to the patient rather than having patients travel to a tier-one hospital, we're really able to treat the disease earlier and have a much better chance of curing the patient."

As the company begins clinical trials to gain approval to use its NMR device in the United States and China, WaveGuide is working to be able to detect ovarian cancer, Stacks said. "The stage-one, five-year survival rate is 85 percent, but, unfortunately, many women present in stages three or four," he noted. "We hope to be able to detect cancer earlier and save lives." There are also plans to create detection systems for other cancers, he said. "There are so many possibilities with this technology – there are a lot of diseases we hope to detect and prevent. We're looking forward to a rosy future."

The company is also exploring ways to use connected devices in industrial applications to make things better in other industries. For example, WaveGuide's revolutionary technology may be used to provide a logging-while-drilling tool for earlier detection of oil and gas in fields and to help deter theft from oil and gas pipelines. WaveGuide is also working on asset protection technology for liquors, food, and pharmaceuticals. For the military, the technology is being developed to enable testing and early detection of failure in machine component systems of military vehicles. "It's a nice balance for us to have, along with healthcare, other industrial applications," Stacks said.

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