



THE BETTER WORLD REPORT *PART ONE*



Building a Stronger Economy:

Profiles of 25 Companies Rooted in Academic Research



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A therapist prepares a patient for radiation treatment on the TomoTherapy® Hi-Art System®.



Chapter **17**



TomoTherapy's Revolutionary Cancer Treatment Zeroes in on Tumors with Precision

Helical TomoTherapy® brand radiotherapy, combined with built-in computerized tomography imaging, targets only the cancerous mass, sparing surrounding tissue and nearby organs from damaging radiation.

University of Wisconsin-Madison

TomoTherapy Inc.

University of Wisconsin-Madison professors Thomas Mackie and Paul Reckwerdt wanted to solve a big problem in cancer treatment therapy — the serious damage to normal tissues and organs created by standard radiation therapy. They were intrigued with the idea of building a machine that could deliver a tightly controlled pattern of radiation that preferentially strikes cancer tumors, sparing the surrounding tissue from harm.

That was just a thought in the early 1990s. Today, TomoTherapy Inc.'s Hi-Art® System is the most advanced radiation therapy device in the world. Physicians in more than a dozen countries use this remarkable technology to customize a treatment plan that delivers a precisely configured field of radiation to the tumor that is essentially the same shape and volume as the tumor itself. With annual revenues of about \$130 million, and a workforce of 500 with 300 more jobs on the way, it's safe to say TomoTherapy Inc., headquartered in Madison, Wis., is a success.

The breakthrough that Reckwerdt and Mackie discovered is called helical TomoTherapy-brand radiotherapy, which creates a helical pattern of radiation around the patient. This allows rotating beamlets of radiation to be directed into the patient's body from any angle, a far better approach than the two or three angles of penetration that traditional radiation therapy has provided.

The second key part of the Hi-Art System is a built-in computerized tomography (CT) scanner. For helical TomoTherapy-brand radiotherapy to be effective, it must be guided with utmost accuracy.

"The CT imaging allows physicians to exactly locate the patient's tumor, see if the shape has changed, and place the patient in perfect position for each session of radiation," says Mackie, an M.D. and UW-Madison professor of medical physics and human oncology, as well as chairman of the board at TomoTherapy Inc.

The initial R&D was undertaken at the University of Wisconsin with a \$250,000 federal grant from the National Cancer Institute. The Technology Transfer Office at the Wisconsin Alumni Research Foundation (WARF) filed its first patent applications on the technology in 1992. WARF also contributed more than \$1 million to help fund continuing research. TomoTherapy Inc. was established in 1997 and five years later its

Hi-Art System prototype was approved by the U.S. Food and Drug Administration. Today more than 100 Hi-Art Systems are in operation around the world. Currently the company holds 70 patents, with at least a dozen others pending.

“Moving to this unique platform is a quantum leap for radiation therapy,” says Richard Hudes, M.D., and chief of the division of radiation oncology at St. Agnes Cancer Center in Baltimore, Md. “Referring doctors need to know that TomoTherapy provides a significantly improved radiation delivery method of unparalleled accuracy.”

A Precise Weapon Against Cancer

Doctors use the CT scanner to map the contours of the tumor, as well as define areas of risk (such as organs) that need to be protected from the radiation. The CT data is logged into the Hi-Art System, which calculates the parameters of the radiation and where it will be focused inside the patient's body. Because cancer tumors can change shape and location on almost a daily basis, regular CT scanning is a great way to fine-tune the treatment for maximum effectiveness.

Because the radiation beam can be configured so exactly, it is the ideal treatment for patients with “untreatable” cancers.

“One of our patients had a tumor growing around the orbital area of his eye,” says John Koenig, director of Froedtert Hospital's Radiation Oncology Center in Milwaukee, Wis., which began using the machine in 2004. “Standard radiation treatment would have caused the patient to lose sight in that eye, but we were able to treat the cancer successfully with TomoTherapy equipment. Tumors on the spine are also difficult treatment areas, but the Hi-Art System can design a plan where the field of radiation actually wraps around the spinal column to deliver radiation to the tumors, without damaging the spinal cord.”

After being scanned, the patient is placed on a table within a tunnel-like device called a gantry ring. Photon radiation in the ring travels in multiple circles around patient, through the gantry ring. The table is moved slowly through the gantry ring as it rotates. Each time the radiation comes full circle, it penetrates the tumor along a slightly different plane. The shape of the radiation beam changes with each slice of treatment, according to the shape of the tumor in that plane. Treatment proceeds for about 15 to 20 minutes until the entire tumor has been radiated.

Not only does the Hi-Art System treat patients who were not treatable before, it can also safely deliver second courses of radiation therapy.

“If a patient’s tumor returns after radiotherapy, it is usually not possible to retreat the same area with conventional radiation treatment because the normal tissues have reached their toleration level,” says Koenig. “But TomoTherapy equipment delivers such a finely tuned dose that even previously irradiated areas can be treated, giving new hope to patients with recurrent disease.”

Moving Ahead

TomoTherapy Inc.’s 80 percent growth rate shows how quickly the health care industry has taken notice of its Hi-Art System. Not only have the medical outcomes been eye-opening, but the price tag of \$3.5 million is actually very competitive with the less-functional systems that most hospitals use. And there’s still plenty of room to grow — TomoTherapy Inc. has only 10 percent of the radiation therapy market.

The company isn’t resting on its laurels — 20 percent of its revenues are reinvested in research and development. Because of its rapid growth, TomoTherapy Inc. recently opened a new operations center in Madison. The \$8.2 million, 66,000-square-foot facility will allow the company to quadruple its current testing and production capacity.

“We use TomoTherapy equipment for almost all our patients,” says Koenig. “Patients know they are getting a more precise treatment that lessens the side effects of radiation. Their quality of life during treatment is much higher, with less nausea, diarrhea, fatigue or hair loss. If TomoTherapy equipment is used in the first course of treatment, it can reduce or eliminate the need for surgery or chemotherapy, which means lower health care costs.”

“Any time we can avoid a complication, we avoid extra cost to the health care system,” adds Mackie. “Our technology may lower the cost of drug care tremendously, which is the most costly part of cancer therapy. For a typical cancer center, the yearly cost of drugs alone would pay for all its radiation equipment.”

“Cancer rates are increasing around the world,” says Mackie. “Cancer is a frightening disease and standard treatment can be painful and debilitating. TomoTherapy has a better way to treat most cancers and our mission is to bring this technology to the global market.”

— By Mark Crawford