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A TALE OF TWO HALVES

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FASTER, SAFER PEDIATRIC IMAGING

Shimadzu's wireless digital radiography system saves doctors time and reduces radiation exposure to children at Children's Medical Center Dallas.

- Shimadzu World Headline from North America and China
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SHIMADZU Excellence in Science

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BY DAVID WOLMAN

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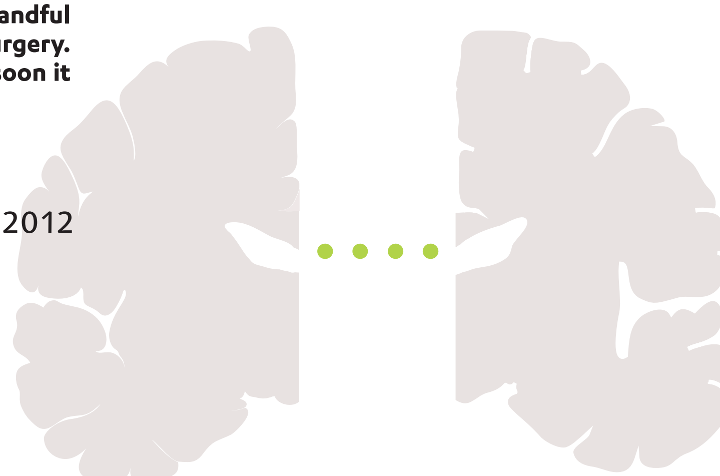


In the first months after her surgery, shopping for groceries was infuriating. Standing in the supermarket aisle, Vicki would look at an item on the shelf and know that she wanted to place it in her trolley — but she couldn't. "I'd reach with my right for the thing I wanted, but the left would come in and they'd kind of fight," she says. "Almost like repelling magnets." Picking out food for the week was a two-, sometimes three-hour ordeal. Getting dressed posed a similar challenge: Vicki couldn't reconcile what she wanted to put on with what her hands were doing. Sometimes she ended up wearing three outfits at once. "I'd have to dump all the clothes on the bed, catch my breath and start again."

In one crucial way, however, Vicki was better than her pre-surgery self. She was no longer racked by epileptic seizures that were so severe they had made her life close to unbearable. She once collapsed onto the bar of an old-fashioned oven, burning and scarring her back. "I really just couldn't function," she says. When, in 1978, her neurologist told her about a radical but dangerous surgery that might help, she barely hesitated. If the worst were to happen, she knew that her parents would take care of her young daughter. "But of course I worried," she says. "When you get your brain split, it doesn't grow back together."

In June 1979, in a procedure that lasted nearly 10 hours, doctors created a firebreak to contain Vicki's seizures by slicing through her corpus callosum, the bundle of neuronal fibres connecting the two sides of her brain. This drastic procedure, called a corpus callosotomy, disconnects the two sides of the neocortex, the home of language, conscious thought and movement control. Vicki's supermarket predicament was the consequence of a brain that behaved in some ways as if it were two separate minds.

After about a year, Vicki's difficulties abated. "I could get things together," she says. For the most part she was herself: slicing vegetables, tying her shoe laces, playing cards, even waterskiing.

But what Vicki could never have known was that her surgery would turn her into an accidental superstar of neuroscience. She is one of fewer than a dozen 'split-brain' patients, whose brains and behaviours have been subject to countless hours of experiments, hundreds of scientific papers, and references in just about every psychology textbook of the past generation. And now their numbers are dwindling.

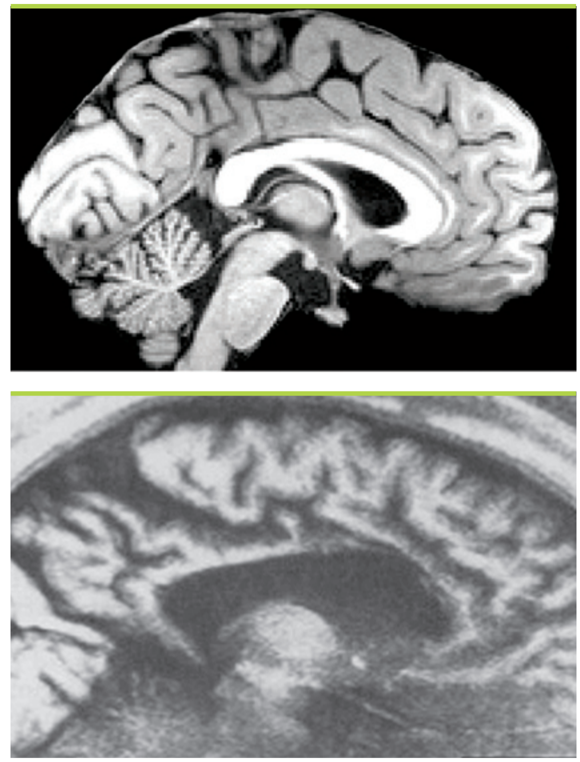
Through studies of this group, neuroscientists now know that the healthy brain can look like two markedly different machines, cabled together and exchanging a torrent of data. But when the primary cable is severed, information — a word, an object, a picture — presented to one hemisphere goes unnoticed in the other. Michael Gazzaniga, a cognitive neuroscientist at the University of California, Santa Barbara, and the godfather of modern split-brain science, says that even after working with these patients for five decades, he still finds it thrilling to observe the disconnection effects first-hand. "You see a split-brain patient just doing a standard thing — you show him an image and he can't say what it is. But he can pull that same object out of a grab-bag," Gazzaniga says. "Your heart just races!"

Work with the patients has teased out differences between the two hemispheres, revealing, for instance, that the left side usually leads the way for speech and language computation, and the right specializes in visual- spatial processing and facial recognition. "The split work really showed that the two hemispheres are both very competent at most things, but provide us with two different snapshots of the world," says Richard Ivry, director of the Institute of Cognitive and Brain Sciences at the University of California, Berkeley. The idea of dichotomous consciousness captivated the public, and was greatly exaggerated in the notion of the 'creative right brain'. But further testing with splitbrain patients gave a more-nuanced picture. The brain isn't like a computer, with specific sections of hardware charged with specific tasks. It's more like a network of computers connected by very big, busy broadband cables. The connectivity between active brain regions is turning out to be just as important, if not more so, than the operation of the distinct parts. "With split-brain patients, you can see the impact of disconnecting a huge portion of that network, but without damage to any particular modules," says Michael Miller, a psychologist at the University of California, Santa Barbara.

David Roberts, head of neurosurgery at Dartmouth-Hitchcock Medical Center in Lebanon, New Hampshire, sees an important lesson in split-brain research. He operated on some of the cohort members, and has worked closely with Gazzaniga. "In medical school, and science in general, there is so much emphasis on large numbers, labs, diagnostics and statistical significance," Roberts says — all crucial when, say, evaluating a new drug. But the split-brain cohort brought home to him how much can be gleaned from a single case. "I came to learn that one individual, studied well, and thoughtfully, might enable you to draw conclusions that apply to the entire human species," he says.

Today, the split-brain patients are getting on in years; a few have died, one has had a stroke and age in general has made them all less fit for what can be taxing research sessions of sitting, staring and concentrating. The surgery, already quite rare, has been replaced by drug treatments and less drastic surgical procedures. Meanwhile, imaging technologies have become the preferred way to look at brain function, as scientists can simply watch which areas of the brain are active during a task.

But to Miller, Ivry, Gazzaniga and others, split-brain patients remain an invaluable resource. Imaging tools can confirm, for example, that the left hemisphere is more active than the right when processing language. But this is dramatically embodied in a split-brain patient, who may not be able to read aloud a word such as 'pan' when it's presented to the right hemisphere, but can point to the appropriate drawing. "That gives you a sense of the right hemisphere's ability to read, even if it can't access the motor system to produce speech," Ivry says. "Imaging is very good for telling you where something happens," he adds, "whereas patient work can tell you how something happens."



The callosum tissue seen in a healthy brain (bright white in top image) retracts after a corpus callosotomy, leaving just the ventricle (black).

A CABLE, CUT

Severing the corpus callosum was first used as a treatment for severe epilepsy in the 1940s, on a group of 26 people in Rochester, New York. The aim was to limit the electrical storm of the seizure to one side of the brain. At first, it didn't seem to work. But in 1962, one patient showed significant improvement. Although the procedure never became a favoured treatment strategy — it's invasive, risky, and drugs can ease symptoms in many people — in the decades since it nevertheless became a technique of last resort for treating intractable epilepsy.

To Roger Sperry, then a neurobiologist and neuropsychologist at the California Institute of Technology, and Gazzaniga, a graduate student in Sperry's lab, split-brain patients presented a unique opportunity to explore the lateralized nature of the human brain. At the time, opinion on the matter was itself divided. Researchers who studied the first split-brain patients in the 1940s had concluded that the separation didn't noticeably affect thought or behaviour. (Gazzaniga and others suspect that these early sections were incomplete, which might also explain why they didn't help the seizures.) Conversely, studies conducted by Sperry and colleagues in the 1950s revealed greatly altered brain function in animals that had undergone callosal sections. Sperry and Gazzaniga became obsessed with this inconsistency, and saw in the split-brain patients a way to find answers.

The duo's first patient was a man known as W. J., a former Second World War paratrooper who had started having seizures after a German soldier clocked him in the head with the butt of a rifle. In 1962, after W.J.'s operation, Gazzaniga ran an experiment in which he asked W.J. to press a button whenever he saw an image. Researchers would then flash images of letters, light bursts and other stimuli to his left or right field of view. Because the left field of view is processed by the right hemisphere and vice versa, flashing images quickly to one side or the other delivers the information solely to the intended hemisphere (see '**OF TWO MINDS**').

For stimuli delivered to the left hemisphere, W.J. showed no hangups; he simply pressed the button and told the scientists what he saw. With the right hemisphere, W.J. said he saw nothing, yet his left hand kept pressing the button every time an image appeared. "The left and right didn't know what the other was doing," says Gazzaniga. It was a paradigm-blasting discovery showing that the brain is more divided than anyone had predicted[1].

Suddenly, the race was on to delve into the world of lateralized function. But finding more patients to study proved difficult. Gazzaniga estimates that at least 100 patients, and possibly many more, received a corpus callosotomy. But individuals considered for the operation tend to have other significant developmental or cognitive problems; only a few have super-clean cuts and are neurologically healthy enough to be useful to researchers. For a while, Sperry, Gazzaniga and their colleagues didn't know if there was ever going to be anyone else like W.J..

But after contacting neurosurgeons, partnering with epilepsy centres and assessing many potential patients, they were able to identify a few suitable people in California, then a cluster from the eastern part of the United States, including Vicki. Through the 1970s and the early 1980s, split-brain research expanded, and neuroscientists became particularly interested in the capabilities of the right hemisphere — the one conventionally believed to be incapable of processing language and producing speech.

Gazzaniga can tick through the names of his "endlessly patient patients" with the ease of a proud grandparent doing a roll call of grandchildren — W.J., A.A., R.Y., L.B., N.G.. For medical confidentiality, they are known in the literature by initials only. (Vicki agreed to be identified in this article, provided that her last name and hometown were not published.)

On stage last May, delivering a keynote address at the Society of Neurological Surgeons' annual meeting in Portland, Oregon, Gazzaniga showed a few grainy film clips from a 1976 experiment with patient P.S., who was only 13 or 14 at the time. The scientists wanted to see his response if only his right hemisphere saw written words.

In Gazzaniga's video, the boy is asked: who is your favourite girlfriend, with the word girlfriend flashed only to the right hemisphere.

As predicted, the boy can't respond verbally. He shrugs and shakes his head, indicating that he doesn't see any word, as had been the case with W.J.. But then he giggles. It's one of those tell-tale teen giggles — a soundtrack to a blush. His right hemisphere has seen the message, but the verbal left-hemisphere remains unaware. Then, using his left hand, the boy slowly selects three Scrabble tiles from the assortment in front of him. He lines them up to spell L-I-Z: the name, we can safely assume, of the cute girl in his class. "That told us that he was capable of language comprehension in the right hemisphere," Gazzaniga later told me. "He was one of the first confirmation cases that you could get bilateral language — he could answer queries using language from either side."

The implications of these early observations were "huge", says Miller. They showed that "the right hemisphere is experiencing its own aspect of the world that it can no longer express, except through gestures and control of the left hand". A few years later, the researchers found that Vicki also had a right-hemisphere capacity for speech[2]. Full callosotomy, it turned out, resulted in some universal disconnections, but also affected individuals very differently.

In 1981, Sperry was awarded a share of the Nobel Prize in Physiology or Medicine for the split-brain discoveries. ("He deserved it," Gazzaniga says.) Sperry died in 1994, but by that point, Gazzaniga was leading the charge. By the turn of the century, he and other split-brain investigators had turned their attention to another mystery: despite the dramatic effects of callosotomy, W.J. and later patients never reported feeling anything less than whole. As Gazzaniga wrote many times: the hemispheres didn't miss each other.

Gazzaniga developed what he calls the interpreter theory to explain why people — including split-brain patients — have a unified sense of self and mental life[3]. It grew out of tasks in which he asked a split-brain person to explain in words, which uses the left hemisphere, an action that had been directed to and carried out only by the right one. "The left hemisphere made up a post hoc answer that fit the situation." In one of Gazzaniga's favourite examples, he flashed the word 'smile' to a patient's right hemisphere and the word 'face' to the left hemisphere, and asked the patient to draw what he'd seen. "His right hand drew a smiling face," Gazzaniga recalled. "'Why did you do that?' I asked. He said, 'What do you want, a sad face? Who wants a sad face around?'" The left-brain interpreter, Gazzaniga says, is what everyone uses to seek explanations for events, triage the barrage of incoming information and construct narratives that help to make sense of the world.

The split-brain studies constitute "an incredible body of work", said Robert Breeze, a neurosurgeon at the University of Colorado Hospital in Aurora, after listening to Gazzaniga's lecture last year. But Breeze, like many other neuroscientists, sees split-brain research as outdated. "Now we have technologies that enable us to see these things" — tools such as functional magnetic resonance imaging (fMRI) that show the whereabouts of brain function in great detail.

Miller, however, disagrees. "These kinds of patients can tell us things that fMRI can never tell us," he says.

SUBJECT OF INTEREST

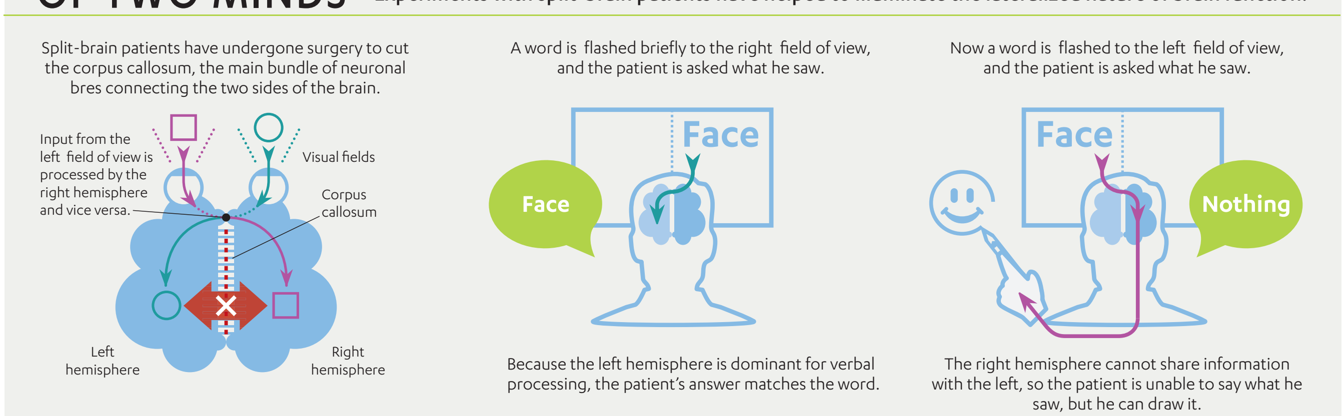
Seated at a small, oval dining-room table, Vicki faces a laptop propped up on a stand, and a console with a few large red and green buttons. David Turk, a psychologist at the University of Aberdeen, UK, has flown in for the week to run a series of experiments.

Vicki's grey-white hair is pulled back in a ponytail. She wears simple white sneakers and, despite the autumn chill, shorts. She doesn't want to get too warm: when that happens she can get drowsy and lose focus, which can wreck a whole day of research.

During a break, Vicki fetches an old photo album. In one picture,

OF TWO MINDS

Experiments with split-brain patients have helped to illuminate the lateralized nature of brain function.



taken soon after her surgery, she is sitting up in the hospital bed. Her hair is starting to grow back as black stubble and she and her daughter have wide smiles. Another page of the album has a slightly faded printout of a 1981 paper from *The Journal of Neuroscience* glued into it: the first published report involving data gleaned from Vicki, in which researchers describe how she, like P.S., had some capacity for language in her right hemisphere[4].

When pressed to share the most difficult aspect of her life in science, the perpetually upbeat Vicki says that it would have to be an apparatus called the dual Purkinje eye tracker. This medieval-looking device requires the wearer to bite down on a bar to help keep the head still so that researchers can present an image to just the left or right field of view. It is quite possible that Vicki has spent more of her waking hours biting down on one of those bars than anyone else on the planet.

Soon, it is time to get back to work. Turk uses some two-sided tape to affix a pair of three-dimensional glasses onto the front of Vicki's thin, gold-rimmed bifocals. The experiment he is running aims to separate the role of the corpus callosum in visual processing from that of deeper, 'subcortical' connections unaffected by the callosotomy. Focusing on the centre of the screen, Vicki is told to watch as the picture slowly switches between a house and different faces — and to press the button every time she sees the image change. Adjusting her seat, she looks down the bridge of her nose at the screen and tells Turk that she's ready to begin.

PHOTO BY MIKE MCGREGOR/CONTOUR BY GETTY

Michael Gazzaniga has worked with split-brain patients for 50 years.

DEEP CONNECTIONS

Other researchers are studying the role of subcortical communication in the coordinated movements of the hands. Split-brain patients have little difficulty with 'bimanual' tasks, and Vicki and at least one other patient are able to drive a car. In 2000, a team led by Liz Franz at the University of Otago in New Zealand asked split-brain patients to carry out both familiar and new bimanual tasks. A patient who was an experienced fisherman, they found, could pantomime tying a fishing line, but not the unfamiliar task of threading a needle. Franz concluded that well-practised bimanual skills are coordinated at the subcortical level, so split-brain people are able to smoothly choreograph both hands[5].

Miller and Gazzaniga have also started to study the right hemisphere's role in moral reasoning. It is the kind of higher-level function for which the left hemisphere was assumed to be king. But in the past few years, imaging studies have shown that the right hemisphere is heavily involved in the processing of others' emotions, intentions and beliefs — what many scientists have come to understand as the 'theory of mind'[6]. To Miller, the field of enquiry perfectly illustrates the value of split-brain studies because answers can't be found by way of imaging tools alone.

In work that began in 2009, the researchers presented two split-brain patients with a series of stories, each of which involved either accidental or intentional harm. The aim was to find out whether the patients felt that someone who intends to poison his boss but fails because he mistakes sugar for rat poison, is on equal moral ground with someone who accidentally kills his boss by mistaking rat poison for sugar[7]. (Most people conclude that the former is more morally reprehensible.) The researchers read the stories aloud, which meant that the input was directed to the left hemisphere, and asked for verbal responses, so that the left hemisphere, guided by the interpreter mechanism, would also create and deliver the response. So could the split-brain patients make a conventional moral judgement using just that side of the brain?

No. The patients reasoned that both scenarios were morally equal. The results suggest that both sides of the cortex are necessary for this type of reasoning task.

But this finding presents an additional puzzle, because relatives and friends of split-brain patients do not notice unusual reasoning or theory-of-mind deficits. Miller's team speculates that, in everyday life, other reasoning mechanisms may compensate for disconnection effects that are exposed in the lab. It's an idea that he plans to test in the future.

As the opportunities for split-brain research dwindle, Gazzaniga is busy trying to digitize the archive of recordings of tests with cohort members, some of which date back more than 50 years. "Each scene is so easy to remember for me, and so moving," he says. "We were observing so many astonishing things, and others should have the same opportunity through these videos." Perhaps, he says, other researchers will even uncover something new.

Other split-brain patients may become available — there is a small cluster in Italy, for instance. But with competition from imaging research and many of the biggest discoveries about the split brain behind him, Gazzaniga admits that the glory days of this field of science are probably gone. "It is winding down in terms of patients commonly tested." Still, he adds: "I have a hard time saying it's all over."

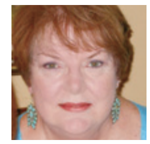
And maybe it's not — as long as there are scientists pushing to tackle new questions about lateralized brain function, connectivity and communication, and as long as Vicki and her fellow cohort members are still around and still willing participants in science. Her involvement over the years, Vicki says, was never really about her. "It was always about getting information from me that might help others."

David Wolman *is a freelance writer based in Portland, Oregon, and the author, most recently, of* The End of Money.

1. Gazzaniga, M. S., Bogen, J. E. & Sperry, R. W. *Proc. Natl Acad. Sci. USA* **48**, 1765–1769 (1962).
2. Gazzaniga, M. S. *Brain* **123**, 1293–1326 (2000).
3. Gazzaniga, M. S. *Science* **245**, 947–952 (1989).
4. Sidtis, J. J., Volpe, B. T., Wilson, D. H., Rayport, M. & Gazzaniga, M. S. *J. Neurosci.* **1**, 323–331 (1981).
5. Franz, E. A., Waldie, K. E. & Smith, M. J. *Psychol. Sci.* **11**, 82–85 (2000).
6. Young, L. & Saxe, R. *NeuroImage* **40**, 1912–1920 (2008).
7. Miller, M. B. *et al. Neuropsychologia* **48**, 2215–2220 (2010).

FASTER, SAFER PEDIATRIC IMAGING

Shimadzu's wireless digital radiography system saves doctors time and reduces radiation exposure to children at Children's Medical Center Dallas.



Linda Boatner

Senior Director of Radiology
Children's Medical Center Dallas

Timothy Cavazos

Radiology Clinical Manager
Children's Medical Center Dallas

A one-kilogram baby is born. His body is weak. His respiratory, cardiovascular, and other vital systems are of uncertain reliability. Over the next months, doctors will be forced to make a multitude of sometimes urgent decisions such as whether umbilical catheters, intravenous lines, and breathing tubes are necessary. If so, the doctors will have to verify that these devices are in the right place. Monitoring, diagnosis, and verification require precise images.

That raises a quandary: x-ray imaging increases the risk of cancer, especially for neonates who are more sensitive to radiation than adults. Even the physical motion of positioning the child for imaging can present problems. The benefits of obtaining timely and accurate diagnostic information, weighed against the risks involved in getting that data, complicate an already stressful situation. Fortunately, however, hospitals around the world are increasingly capable of obtaining high quality images to care for premature and underweight babies, as well as a wide variety of other disorders affecting neonates and children, while limiting radiation exposure.

Children's Medical Center Dallas takes this balancing act very seriously. As one of the top pediatric hospitals in the United States—with more Joint Commission Disease Specific Care Certifications than any other pediatric hospital—Children's Medical Center Dallas Radiology is constantly working to reduce radiation exposure while working to provide patients the best-informed care. It has, for example, taken a dedicated role in the "image gently" campaign, initiated by the Alliance for Radiation Safety in Pediatric Imaging launched in 2007. The campaign aims to change pediatric care "by increasing awareness of the opportunities to promote radiation protection in the imaging of children." The technologists at Children's have all pledged to enhance the protection of children and optimize protocols to achieve that. The radiologists consult with referring physicians to reduce avoidable ionizing radiation by recommending other imaging techniques, such as ultrasound or MRI whenever these tests will produce the required diagnostic information at a similar quality level. New instruments are bolstering their efforts. Shimadzu's Digital Radiographic Mobile X-ray System (MobileDaRt/MobileDaRt Evolution), for example, has allowed a drastic reduction in radiation and a host of other benefits for enhancing pediatric care.

The efforts have paid off. Overall CT utilization at Children's dropped 34% between the beginning of 2008 and the end of 2010. Much of this change was due to the strategic use of non-ionizing imaging tests. For example, the medical center's health providers replaced some CT imaging with ultrasound when diagnosing children with severe abdominal pain, a symptom often indicating appendicitis. "With this reduction in CT utilization, we deinstalled and sold one of our scanners. We are very proud of this reduction in radiation to our kids," says Linda Boatner, the center's Senior Director of Radiology.

But technical advance has also played a large role. Digital radiography, by converting x-ray photons to a digitally processable charge that is picked up by extremely sensitive detectors, has allowed health professionals to use lower radiation levels to get an image. Shimadzu's MobileDaRt was the world's first mobile digital radiography system to produce instantaneous images on wireless flat panel detectors. Shimadzu was also the first to introduce smaller flat panel detectors, which enable further reductions in radiation exposure. Overall the x-ray doses can be lowered by as much as half, says Timothy Cavazos, a Radiology Clinical Manager at Children's. "That's a great benefit to the patient, and fits our philosophy of getting radiation levels as low as reasonably achievable," he says. "And the resolution is still very high. We're not compromising on that."

The instantaneous display offered by the MobileDaRt is crucial. The immediacy minimizes the stressful times during which families wait for a diagnosis, and frees up health professionals to help other patients. Most importantly, doctors can decide on the

MobileDaRt Evolution

The Shimadzu Mobile X-ray System MobileDaRt Evolution at Children's Medical Center Dallas

spot for their next intervention without a long wait for the image. That decreases treatment time, says Boatner.

The Shimadzu direct radiography system eliminates the time-consuming steps of replacing and transferring computed radiography cassettes and manually entering patient information. This shaves off more than 60% of the time needed for these procedures and allows immediate analysis of images by any doctor in the hospital. When using the Shimadzu RADspeed DR Dual Panel system, the whole operation becomes more efficient, convenient, and safe for the patient. Anatomical programming can be used to set pediatric protocols and trigger the x-ray collimator, which focuses the radiation beam on body parts being studied and prevents exposure to others. The overhead auto-positioning mechanism enables the technologist to effortlessly pinpoint the exact position and angle for the x-ray tube, freeing them to focus on the patient's needs. "Auto-stitching" assembles different images, taken while the x-ray tube and detector plates move in coordinated fashion, into a larger composite image. "Shimadzu is very attentive during installation and applications, implementing our specific anatomical programming preferences," says Boatner. Shimadzu worked patiently to enable the wireless application to interface with the security protections of the Medical Center internal network —like the need to encrypt data for wireless transmission. "Shimadzu's been an excellent partner" says Boatner.The upshot of all this convenience is higher productivity. In each of the three radiography rooms in the orthopedics unit at the center, for example, technologists can take high quality images of some 70 patients per day—compared to the 30 per room previously. "It's a very busy clinic with many physicians who want their images quickly," says Cavazos. "There's no way we could do that without the direct radiography system."

But radiation reduction is the biggest benefit, especially for those born extremely underweight, who often have a variety of respiratory problems. "Some neonates can potentially receive more than one chest x-ray in a day. If you can decrease the radiation by 50%, as with the cesium iodide detector, you're way ahead of the curve" says Boatner. The MobileDaRt Evolution also minimizes the need for contact with the fragile patients who are often connected to various tubes. "It can be precarious. Slight movement can pull those out," says Cavazos. With the MobileDaRt Evolution, the wireless detectors can be inserted directly into a drawer of the bed under the child. "We don't have to move the delicate baby at all. That has been a great improvement," says Cavazos.

As part of the Children's Medical Center Dallas ongoing efforts to improve pediatric care, it will add an eighth MobileDaRt Evolution system and start upgrading older systems with the new detectors. Originally purchased for the Emergency Department, "soon every intensive care unit wanted one as well," says Boatner.

The center is also sharing its experience with other pediatric hospitals. Encouraged by experiences such as that at Children's Medical Center Dallas, the Child Health Corporation of America signed a group purchasing contract with Shimadzu to make the MobileDaRt Evolution system more widely available. Success breeds success even in other areas: radiation reduction spurred by the "Image Gently" campaign and made possible by devices such as MobileDaRt/MobileDaRt Evolution have worked so well that medical practitioners in other institutions are transferring radiation reduction strategies to adult care—the "Image Wisely" campaign. "We're all moving toward the same safety goal," says Boatner, "reduction in radiation exposure to our patients".

The MobileDaRt has transformed imaging at Children's, and the first two units arrived just in time. Two weeks after receiving them, water pipes broke, flooding the radiology department and knocking out two x-ray rooms for a month. Mobile and convenient, the MobileDaRt met many of the emergency department needs. "It was amazing," says Boatner. "It was quite an ordeal. I'm not sure what we would have done without them."

Shimadzu World Headline

Shimadzu introduces bases in countries around the world.

25th Anniversary of Shimadzu Medical Systems, USA

North America

2012 marks the 25th year since Shimadzu Medical Systems, USA (SMS) was founded. Ever since it started with only four staff members in 1987, SMS has remained steadfastly committed to providing Shimadzu value that satisfies customer needs.

Shimadzu led the world in releasing the MobileDaRt series digital mobile X-ray system in 2005. It was developed based on the customer feedback in U.S. The Mobile DaRt X-ray system takes on-the-spot X-ray images and immediately sends them to an X-ray reading room over a network. It has revolutionized hospital workflows and remains at the forefront of global markets.

The RADspeed DR digital radiography system offers a user-friendly interface and instantaneous image display that perfectly match the needs of the market. This product has attracted considerable attention in the North American market where efficiency is especially valued.

Shimadzu currently enjoys about 30 % of the U.S. digital mobile X-ray system market, and the RADspeed DR has earned the "Best in KLAS" award from an independent accreditation organization in the U.S. four years in a row. Shimadzu is now an established brand of radiography systems in the U.S. SMS will continue to put the customer first by applying Shimadzu's technologies and adding value through a comprehensive range of applications. We will continue to strive to allow as many customers as possible to benefit from Shimadzu products.

Beijing Shimadzu Medical Equipment Co., Ltd. (BSME)

China

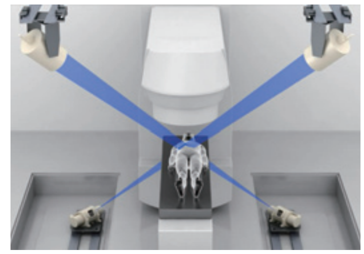
The Chinese medical equipment market has grown significantly by riding the digitization wave since about 2004 and thanks to government policies from 2009 to reform the medical system. During this period of growth, BSME, a manufacturing company of medical equipment for China, began the local production of models for the Chinese market that are normally manufactured in Japan. BSME also started developing new products tailored to Chinese market requirements, such as adding new functionality to systems developed in Japan.

For example, the D-VISION R/F is the unique system for Chinese market which BSME incorporates an R/F table offered in the Shimadzu Corporation product range with a general purpose FPD. It was commercialized by BSME based on a concept proposed by the technical service department at Shimadzu (China) Co., Ltd. (SSL), a Shimadzu sales company in China. Because the D-VISION was tailored to the needs of customers in China and released in advance of competitors, it was well received by the medical industry to become the digital R/F market leader in China.

BSME has made significant contributions to the medical field in China by fully exploiting economies of scale to reduce manufacturing costs, improving product quality, and increasing the proportion of domestic production. BSME aims to expand sales by continuing to contribute to the medical industry in China by cooperating with SSL to release the unique and leading products that are demanded in the Chinese market.

News & Topics from Shimadzu

New Real-Time Tumor-Tracking Technology Developed for Next-Generation High-Precision Radiotherapy for Cancer and Other Diseases



When radiation is used to treat tumors situated in the lungs, liver, or other areas that change shape or position in accordance with respiration, X-ray exposure can damage surrounding normal cells. Accordingly, there is a real need for technology capable of irradiating only the cancerous tissue with high precision. In recent years, Shimadzu has been focusing its efforts not only on X-ray diagnostic imaging systems for diagnostic fields, but also in therapeutic fields. In November 2011, Shimadzu, in cooperation with Hokkaido University, successfully developed a prototype of real-time tumor-tracking system for next-generation high-precision radiotherapy. This ground-breaking method of radiotherapy is capable of exposing tumor sites to X-rays with pinpoint precision. Shimadzu intends to commercialize this achievement as soon as possible and promote using the resulting new systems for clinical applications in order to improve radiation medical technology and contribute to cutting-edge cancer treatment.

Release of the World's First Commercialized Digital Radiographic Mobile X-Ray System Capable of Using Two Wireless Flat Panel Detectors

Shimadzu has now released MobileDaRt Evolution, the first commercialized digital radiographic mobile X-ray system in the world that can be equipped with two wireless flat panel detectors. This system not only offers standard features that enable confirming images three seconds after exposure, but also can be equipped with two easy-to-handle wireless flat panel detectors. This functionality, along with other enhanced features, allows significantly improving the workflow of medical care personnel involved not only in clinical rounds at hospitals with a large number of patient rooms, but also in emergency medical treatment and on-site medical treatment following earthquakes or other disasters. In particular, the compact, high-sensitivity wireless flat panel detectors achieve lower patient exposure and smoother radiographic positioning than ever before. As the world's first commercialized mobile X-ray system to feature compact flat panel detectors, it will provide powerful support for neonatal examinations at NICU (neonatal intensive care units).

MobileDaRt Evolution

Release of Three Types of New Mass Spectrometers in Response to Demands for Advanced Analysis from the Environmental, Food and Pharmaceutical Fields

The analysis of trace quantities of components is required in a wide range of fields where one needs to analyze blood-borne medicines and metabolites, residual pesticides in foods, and veterinary pharmaceutical products, and to detect environmental pollutants in tap water and environmental water. The number of components that need to be detected increases year by year, and there is a strong need for faster analyses. In order to accommodate these needs, Shimadzu has released the GCMS-TQ8030 ultra fast triple quadrupole gas chromatograph mass spectrometer. In addition, Shimadzu has simultaneously introduced the LCMS-8040 and LCMS-8080 ultra fast triple quadrupole liquid chromatograph mass spectrometers, expanding its line of products in the UFMS (Ultra Fast Mass Spectrometry) series, which features world-class ultra high speeds, high sensitivity, and high selectivity.

LCMS-8040 Liquid Chromatograph Mass Spectrometer

LCMS-8080 Liquid Chromatograph Mass Spectrometer

GCMS-TQ8030 Gas Chromatograph Mass Spectrometer

Shimadzu to Manufacture Two Key Components of Flight Control System for Boeing Aircraft

Since Shimadzu's achievements in the development of flight control systems were highly evaluated, Shimadzu signed the contracts to manufacture Horizontal Stabilizer Trim Actuator for Boeing 787 model aircraft and Horizontal Stabilizer Elevator Feel Actuators for Boeing 737/747/767 model aircrafts.

These productions make Shimadzu newly in charge of a new business field of Commercial Aircraft Flight Control System. By taking advantage of the experience for these two key components, Shimadzu aims to expand its business in the commercial aircraft market which is expected as the future growth market.

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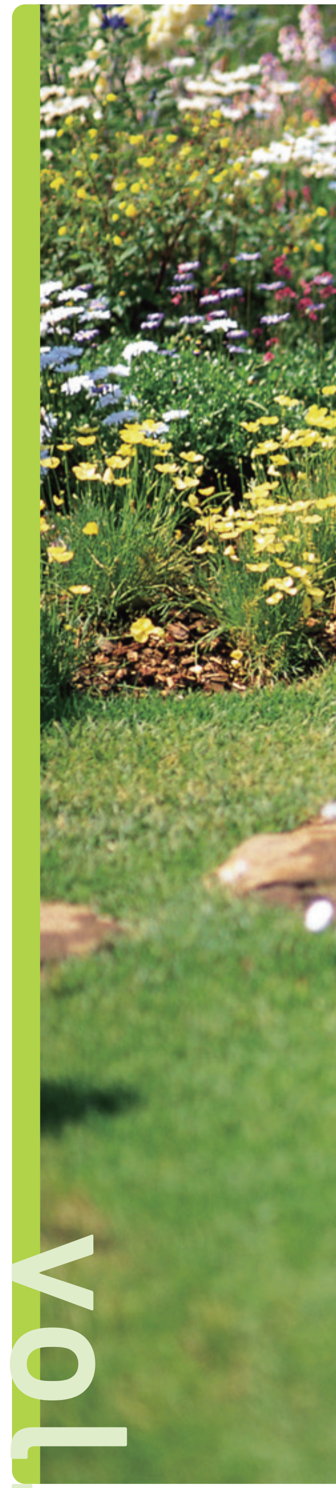

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