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M.R.I.'s Strong Magnets Cited in Accidents

By DONALD G. McNEIL Jr.

The pictures and stories are the stuff of slapstick: wheelchairs, gurneys and even floor polishers jammed deep inside M.R.I. scanners whose powerful magnets grabbed them from the hands of careless hospital workers.

The police officer whose pistol flew out of his holster and shot a wall as it hit the magnet. The sprinkler repairman whose acetylene tank was yanked inside, breaking its valve and starting a fire that razed the building.

But the bigger picture is anything but funny, medical safety experts say. As the number of magnetic resonance imaging scanners in the country has soared from a handful in 1980 to about 10,000 today, and as magnets have quadrupled in power, careless accidents have become more frequent. Some have caused serious injuries and even death.

No one knows how many have occurred. But the safety experts say there is no doubt they are on the rise, and their growing frequency is prompting widespread calls for more regulation.

Safety guidelines drawn up by the American College of Radiology in 2002 and revised last year "have no teeth and are floating out there in intellectual Never-Never Land," Tobias Gilk, a Kansas City architect who designs medical scanning rooms, said.

He continued: "The X-ray in your dentist's office is more heavily regulated."

Dr. Emanuel Kanal, the lead author of the radiology college's guidelines, said that although he would prefer to see radiologists police themselves, the escalating number of blunders and the indifference of some scanner operators to voluntary rules have convinced him that it would be better if federal or state law mandated them.

Right now, he said, the only power in the guidelines he drew up is that malpractice lawyers suing radiologists cite them as standards they should have met.

Although there are ways to make scanning rooms safer - with architectural changes, new types of metal detectors, and precautions to ensure that patients and visitors are not wearing or carrying ferromagnetic metal - the measures are not required by law or the medical profession, and only some scanner operators use them.

The magnets are never off, even at night, and cutting the electricity will not affect them. They draw most of their power from supercooled helium, which must be vented to shut down the magnet - a process that takes several minutes and has hazards of its own.

Most accidents are caused by human error, not scanner malfunction. Although the Food and Drug Administration approves the scanners as medical devices, it does not regulate how their operators behave.

Scanner manufacturers like General Electric and Siemens may suggest safer room designs to customers, but cannot require them. A representative of the National Electrical Manufacturers Association, which includes scanner makers, says companies offer safety training and advice to the makers of hospital equipment used near scanners.

Like other experts, Mr. Gilk and Dr. Kanal, a radiology professor at the University of Pittsburgh Medical Center, emphasized that properly done M.R.I. scans are perfectly safe for patients and that millions are done every year without incident. Magnetism, unlike X-rays or nuclear medicine, has no known [cancer](#) risk.

But accidents are another matter. Exactly how many happen is unknown, because operators are not required to report near misses or minor injuries. Even a serious injury caused by a flying object may not be reported as an M.R.I. accident, because the patient was not hurt by the scanner itself.

The F.D.A. maintains a medical device accident database, which includes M.R.I. accidents, but it records fewer than 100, most of them filed by scanner companies, which learn of them only if the machine is damaged.

Dr. John Gosbee, director of patient safety information systems at the Veterans Administration National Patient Safety Center, estimated that "close calls in M.R. centers probably happen once a month."

One study of all incidents at scanners used at University of Texas hospitals led to an estimate that each scanner would have a serious accident about once every five years.

Dr. Kanal said he had personally heard of accidents "dozens of times a year," often from lawyers, and said the F.D.A.'s database is "not even the tip of the iceberg."

In almost every case, he said, the problem was what he called "pilot error" - personnel who let ferromagnetic objects into the room or failed to detect them in scanned patients.

The roughly 10,000 scanners in the United States are found not just in hospitals, but in storefront clinics and even mounted on trucks, making rounds of small hospitals or parking at malls to do scans for a fee.

Dr. Kanal said operations range from "places where safety is paramount" to "bottom-dwellers whose attitude is: 'As long as I don't get sued, I'm happy.' "

The most notorious accident was the death of 6-year-old Michael Colombini in 2001 at the Westchester Medical Center in Valhalla, N.Y. He was sedated in a scanner after a brain operation when his oxygen supply failed. An anesthesiologist ran for an oxygen tank and failed to notice that the one he found in the hall outside was made of steel. As he returned, the tank shot out of his hands, hitting Michael in the head.

Dr. Moriel NessAiver, a physicist who teaches M.R.I. safety in Baltimore and has pictures of chairs, polishers and other equipment jammed in scanners on his Web site (www.simplyphysics.com/), said he once helped pull a gurney with a patient on it off a scanner, but it took four men to do it.

Most modern surgical staples, artificial joints, cardiac stents, pacemakers and such are made of titanium, stainless steel or other nonferromagnetic metals. But at least one patient died when a 15-year-old metal aneurysm clip on an artery in her brain was dislodged, and two adults with early-model pacemakers died during or shortly after scans.

Scanners can also generate currents in other metals, and many unconscious patients have suffered burns - usually minor - when wires looped on bare skin have heated up.

Shrapnel and machine-shop debris can also cause problems. In the 1990's, one patient was blinded in an eye when a metal sliver in it from an earlier accident moved. Unexpected items, from foil-backed nicotine patches to tattoos with iron oxide ink, present risks.

Scanners can also pose a danger during emergencies. In Freiburg, Germany, a fireman fighting a blaze elsewhere in the hospital was sucked into the scanner's bore by his air tank. Folded in half, with his knees pressed into his chest, he nearly choked to death.

For emergencies, the scanners have so-called quench buttons that expel the liquid helium that powers the magnets. It erupts in a frigid blast, expanding 760 times, and can injure anyone near the vent.

The vent pipe can also rupture, shooting supercold air into the scan room, driving out oxygen and jamming its doors shut. Dr. Kanal has a videotape in which the pressure blew off a ceiling. The simplest accidents can be avoided, experts said, by careful practices: by keeping scanners behind locked doors, by requiring patients to wear gowns, and by questioning them twice about implants or accidents with metal. When a patient is unconscious or unsure, checks for scars and X-rays should be added.

Tanks, chairs and other items made of plastic, aluminum or other nonmagnetic materials are supposed to be used exclusively.

But even making patients don gowns is difficult, Mr. Gilk said. Most scanner operations are businesses, and laundry and changing rooms add to costs; patients prefer less inconvenience; and small amounts of metal, like zippers or buttons, are safe if they cannot come loose.

In the wake of Michael Colombini's death, many operators installed metal detectors, but they were so sensitive that even bra hooks set them off, irritating patients and workers, said Kemp Massengill, president of Mednovus, a California company that makes a new generation of detectors that respond only to ferromagnetic metals like iron, nickel and cobalt.

But the new detectors are expensive, and there is nothing to say they would do a better job than an alert staff.