GEOFFREY HOLMAN

Seated at one of Dartmouth's two tooth dosimeter prototypes are, from the left, Ben Williams, Ann Flood, and Hal Swartz.

DMS researchers go tooth and nail at the problem of radiation exposure

If a terrorist detonated a nuclear weapon or a dirty bomb in a U.S. city, it would be hard for emergency responders to figure out who needed treatment for radiation exposure and who didn't. They'd have to rely on symptoms that don't always correlate with the degree of exposure, such as time to onset of vomiting.

Tests: Lab tests can give more precise estimates, but they are "wildly impractical" after a major event, says Dr. Harold Swartz, director of the Dartmouth Biodosimetry Center for Medical Countermeasures Against Radiation (Dart-Dose).

Dr. Robert Gougelet, a member of the DMS faculty and director of the New England Center for Emergency Preparedness, agrees. "In a mass casualty," he says, existing assessment methods don't offer "the real information that we need."

So Swartz, with input from Gougelet, has been leading a team of physician-scientists and engineers to develop devices that estimate an individual's exposure to ionizing radiation by screening their fingernails and teeth. The field is broadly known as biodosimetry. The most developed Dart-Dose device is a tooth dosimeter, which detects the concentration of unpaired electrons in tooth enamel.

Free electrons are generated in any irradiated tissue, says Dr. Benjamin Williams, a medical physicist who leads the tooth dosimetry effort. "In most tissues, those electrons will recombine," he says. But in tooth enamel, they stay unpaired.

In tooth enamel, free electrons don't recombine but stay unpaired.

Teeth: The feasibility of using teeth to measure radiation exposure was first suggested by Swartz in the 1960s. But it's only in the last 10 years that his ideas are coming to fruition.

With $16.6 million from the National Institutes of Health, plus funds from the Department of Defense, the Dart-Dose team has built two tooth dosimeter prototypes, while also exploring fingernail dosimetry.

One tooth dosimeter is at Dartmouth and is being used for ongoing development. The other is at Dana Faber Cancer Institute in Boston, where it is being used on patients who receive radiation before a bone marrow transplant, as a test of the device's accuracy in a case where the radiation dose is known.

Next, the team will work with GE to improve the device's speed, accuracy, automation, and portability and to apply for Food and Drug Administration approval. Dart-Dose, GE, and other collaborators have also just agreed on the terms of a multiyear contract for up to another $29.8 million in funding for the project from the Biomedical Advanced Research and Development Authority, a federal agency.

While Swartz and Williams are excited by this progress, they hope the dosimeter never has to be used after a terrorist attack—or a nuclear accident, like the recent one in Japan. Early on during that crisis, Swartz was sought out by the media, including the *New York Times* and National Public Radio, and he also talked with Japanese authorities about possibly sending them one of the Dartmouth dosimeters.

Levels: That didn't end up happening. "Our device is designed for relatively high levels," Swartz says, and "for a circumstance where you don't have any prior knowledge as to whether somebody's been exposed or not," and that wasn't the case in Japan.

But the crisis in Japan did highlight another issue—fear. A machine like the tooth dosimeter could reduce anxiety after an accident or attack by giving people data about their exposure.

Understanding how the public would react to such a device is the work of another member of the Dart-Dose team, Dr. Ann Flood. She explores such questions as whether people would rather send fingernail clippings to a lab or have their teeth measured immediately.

"You've got to deal with the realities of people and their needs," says Swartz. The Dart-Dose team must also make sure its devices mesh with emergency response systems like the one Gougelet leads.

Real: "We want to have real devices that fit into the real world," Swartz says. Even if those devices wind up never having to be used. JENNIFER DURGIN