SUNDAY NEWS
SPECIAL REPORT

Spies in the sky

High-tech wizards spotting tumors missed by doctors

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The idea came to Susan Blumenthal in the spring of 1994. Blumenthal had lost her mother to breast cancer 20 years earlier, and she wondered why the military, with all its fancy technology, couldn't help other, similarly stricken women.

"Everyone had seen the images used to guide the smart bombs down chimneys in Iraq during the Gulf War," says Blumenthal. "And most of us were mesmerized by the little rocks on the surface of Mars that could be seen through the Hubble telescope."

To Blumenthal, then, it was a "no-brainer. If the intelligence agencies had the capacity to detect small, hidden objects, then that capability could be used to see small breast cancers."

And why shouldn't the defense and intelligence establishments help, Blumenthal asked herself. "Everyone was talking about a peace dividend after the Cold War," she says. That's when she began pushing "the application of all the intensity and money that went toward getting us ready to fight the Soviets that could be directed toward solving nonmilitary problems at home."

"It was really a common-sense notion, and not exactly new," says Blumenthal. But until she raised the question, the intelligence agencies had rarely wandered into the world of purely civilian problems. What Blumenthal had going for her, besides being a doctor, which meant she knew what she was talking about, was her role as the first federal official specifically tasked to oversee women's health issues in the U.S. Department of Health and Human Services.

So when Blumenthal, who is now the assistant U.S. surgeon general, called the Central Intelligence Agency to pursue her idea, the CIA director quickly took her call. And that began a process that continues to this day — the application of intelligence community expertise to the war on breast cancer.

This is the story of the efforts Blumenthal inspired and the state of breast cancer detection, an ongoing tale of the battle against the second leading cause of death among U.S. women. Today, a new case of breast cancer will be diagnosed every three minutes.

Within months of Blumenthal's first call to the CIA, a task force of intelligence community image analysts and cancer doctors was officially challenged to combine their thinking in order to catch breast cancers sooner than they did then (and still do now).

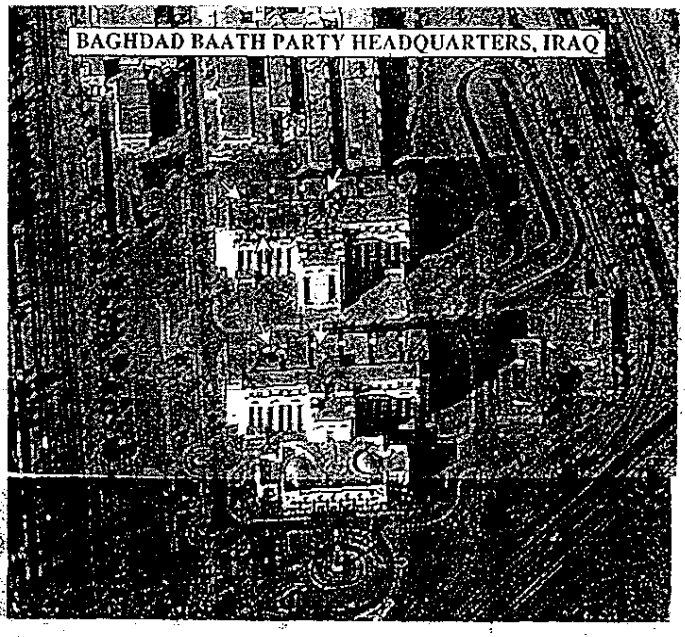
The government's image analysts, scattered in numerous agencies under the general supervision of the director of central intelligence, are the people who view satellite photographs of otherwise ordinary-looking landscapes and determine that things such as enemy missiles lurk beneath those placid scenes.

"Blumenthal is right," says Darryl Garrett, the chief technologist at the National Imagery and Mapping Agency. "What we do in selecting targets [which is all top secret], and what radiologists do in trying to find cancers is essentially the same thing. We both want to find the hidden stuff that's hard to find, the things our enemies, or our bodies, mask from view."

The urgency of Blumenthal's challenge isn't hard to understand: When identified early, breast cancer can be easily and inexpensively treated, and the survival rates are high. But many cancers are missed — or not caught early enough — and not simply because too many women still fail to get regular mammograms.

Cancers are missed for basically two reasons that involve the limitations of conventional mammograms and the limitations of those who interpret them.

Dr. Susan Blumenthal triggered drive to harness military technology.



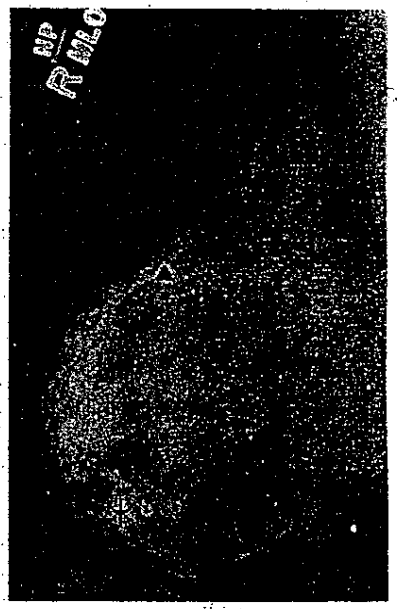
First, roughly 40% of women have breasts with tissue so dense that it is exceedingly hard to spot small cancers using the available technology. And unless a cancer is detected and treated before it grows to about one centimeter, the chances for successful treatment are cut sharply.

The other reason that mammograms are less helpful than advertised involves those who read them. Simply put, there are too few experts dealing with too many mammograms to devote enough time to study them thoroughly. The statistics vary, but the consensus is troubling: Between 15% and 30% of cancers are missed (until they grow unacceptably large) because of what might be called "radiologist fatigue."

On average, a radiologist has less than a minute to read a mammogram, compare it with a woman's earlier X-rays and determine that something suspicious is going on. Many studies report what you would expect: A radiologist's productivity — the ability to read a mammogram correctly — falls off rapidly as the day goes on.

"Think of it as you do the keys on your desk," says Harvard's Dr. Daniel Kopans, one of the nation's leading radiologists. "You leave your keys in plain view and can't find them until someone points them out to you, right in front of your face. That same kind of supposedly inexplicable failure happens all the time to radiologists." In some offices, two radiologists screen the same mammogram, a double-check that is unfortunately too expensive and labor-intensive for most medical practices.

It was these realities that caused Blumenthal to seek a technological way to improve the accuracy of mammograms, a search that is only now even beginning to prove effective in the real world — thanks mostly to an intelligence community effort costing several million dollars under the watchful eye of Sen. Bob Kerry (D-Neb.), who has made sure the money and focus continue.



Most of the exciting work has been done at the National Information and Display Laboratory, or NIDL, a quasi-government agency that spends most of its time looking for military targets via satellite images.

Mammogram readers face two basic challenges: The first involves detecting the small clusters, called microcalcifica-

SPECIAL REPORT

vs. breast cancer

W TARGET Dr. Kevin Kirshenbaum of Illinois Masonic Hospital (above) uses technology that led on Iraq to detect breast cancer.

ns, where breast cancers often live and ow. Working with researchers at the iversity of Chicago, NIDL scientists ve adapted satellite-image analysis ethods to find cancer patterns in large, herwise benign masses.

For intelligence purposes, this method- gy can determine that small clusters of ildings tend to be located near road- ys. In breast imaging, it can determine at cancers tend to flourish near long es of connective tissue.

In various studies, the NIDL technique s reduced the "false positive" rate by out half. False positives occur when ra- ologists, unsure of what they're seeing, l for further mammography or biop- s of breast tissue, additional examina- ns that many women naturally find in- idating.

Without this new system of computer- led detection, called CAD, four of five spicious masses in breasts are typically nd to be benign.

The second challenge radiologists con- nt in searching for breast cancers is problem of comparing mammograms r time. In much of mammography, ra- ologists are looking for change — nething new and different, and thus sibly cancerous.

n defense intelligence, a spy plane or satellite picture might be taken of a suspected missile site one day and sometime later another picture will be taken — but from a different angle. The question is: Can the analyst detect significant change in the area, despite the normal variations due to camera angle, resolution and other factors?

Because of the elastic nature of breast tissue — and variation in breast positioning when mammographic images are taken at different times — radiologists face the same issue: What has actually changed, and is a particular change significant? The NIDL-assisted effort has produced a new machine called the ImageChecker, manufactured by R2 Technology, a California company that just recently won approval from the Food and Drug Administration to market the device. At about $190,000 apiece, the ImageChecker is being used at 29 locations across the U.S., but so far in the New York area only at South Nassau Community Hospital in Oceanside, on Long Island.

The best way to understand what the ImageChecker does is to think of it as you do the spell-checking function in a computer program. The ImageChecker doesn't tell a radiologist if something in a breast is cancer. Nothing yet can do that. Rather, the ImageChecker acts as a second reader. It flags suspicious lesions so a radiologist can take another look.

"We haven't had it long, but we're pleased with it," says Dr. Kenneth Richman of South Nassau. "It's caught things we've missed. So far, what it's found hasn't proven cancerous, but we wouldn't have even investigated those areas without the device."

At this point, machines such as the ImageChecker labor under a serious limitation: They must convert mammographic X-rays to digitized displays before they can be investigated. Because of that, says Paul Sadja, a NIDL image specialist, "a lot is lost in the translation. It would be far better to work with a digitized mammogram to begin with — just as doctors have used digitized representations in other medical fields for years."

Digitial mammographs offer other benefits besides a more precise reading of a particular mammogram's display. Perhaps the greatest advantage is this: If a mammogram can be expressed as a series of numbers — as all digitized displays are — one mammogram can be aligned with another and then, to use the scientific term, the differences can be "subtracted out." What's left is change — something a human radiologist can then study more closely.

Another vital difference is that digital mammograms can be an important tool in telemedicine. In other words, a digital mammogram can be acquired anywhere and transmitted to a radiologist working somewhere else. In fact, the U.S. Army (which after the National Cancer Institute is now the second largest funder of breast cancer research in the country) has already spent close to $2 million to build a mobile van that can visit remote locations for exactly this purpose.

Breast cancer is the second leading cause of cancer deaths in women
(the first is lung cancer)

But the van has yet to roll — not because the digital technology isn't available, but because the FDA hasn't approved it yet.

"It's frustrating," says Greg Mogel, an Army doctor who echoes the view of most radiologists. "The FDA should have approved the digital mammogram device long ago."

The stumbling block, says Dr. Dan Shultz, the acting director of the FDA office that approves radiologic devices, "is the law. By statute, we insist that a product be proven both safe and effective before we will permit its being used in the U.S.

"The European and Canadian philosophy is different," says Shultz. "Outside the U.S., a product can be sold if it is deemed safe. Then, as it is used, its effectiveness is determined."

There's no doubt that America's more conservative approach has saved consumers from all kinds of overhyped drugs and medical devices. But because the application of digital solutions to medical problems has already been widely accepted in many other areas, why is mammography trailing?.

"All I can say is that we're working on it," says Shultz. "What I can't say is when exactly we'll approve digital for use here."

General Electric, the primary maker of the digital mammography system, has just begun shipping the devices to Europe and Canada.

"The beauty of digital," says G.E.'s Bruce Griffing, "is that it allows you to manipulate the image, whereas filmed mammograms are just like pictures taken with a filmed camera: What you've shot is pretty much what you're stuck with. Think of how TV reception improves when you fiddle with the contrast and brightness buttons. It's the same thing with digital mammography."

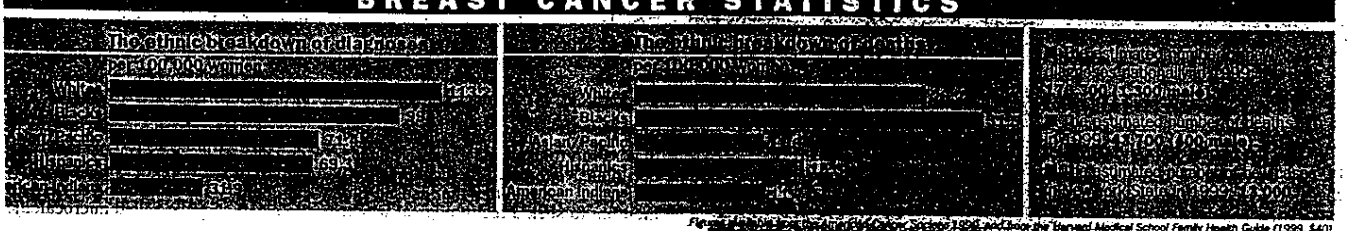
At Berlin's Charite Hospital, which began using the G.E. machine on Sept. 1, the chief radiologist is enthusiastic.

"In our clinical studies," says Bernd Hamm, "[the digital machine] detected breast cancers earlier and with a higher degree of confidence than previously possible." What's more, says Dr. Karina Bukhanov, the head of breast imaging at Mount Sinai Hospital in Toronto (who got the digital device three weeks ago), "the CAD software that R2 has developed will work much better with a digital machine. It's a perfect marriage of technologies."

A perfect marriage that has yet to be consummated in America. To those such as the Army's Greg Mogel, the fact that a U.S.-developed technology is being used in Europe first is incomprehensible. "This is something that can save lives right now," he says. "And we don't have it."

Americans will. The question is when. So the future is here — almost — and when it arrives, no one familiar with what Blumenthal began in 1994 doubts that more women will survive breast cancer.

BREAST CANCER STATISTICS



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