Patients are clamoring for convenience and the Arizona Telemedicine Program is answering the call. What will the repercussions be for the healthcare industry?
At Tucson Breast Center, women get their biopsy results within hours and meet with an oncologist the same day. We examine the repercussions for the healthcare industry.

There are a lot of problems with our current healthcare system, but from the patient's perspective, perhaps none is more glaring than having to wait days or weeks for the results of a cancer biopsy. Dr. Ronald Weinstein and his team at the University of Arizona College of Medicine have come up with a solution to this problem that will likely have repercussions throughout the healthcare industry.

By combining digital mammography, rapid tissue processing, and telemedicine, patients at the Tucson Breast Center can have a breast biopsy, receive the lab results, and speak with an oncologist—all in the same day.

“We have a million women a year who get breast biopsies. Eighty percent are benign, yet everyone thinks they have cancer until they get the report. It has to stop,” said Weinstein, professor and chair of the dept of pathology at the University of Arizona College of Medicine and director of the Arizona Telemedicine Program.

Weinstein is not satisfied to simply reduce the length of time it takes to get mammogram results or biopsy results, however. He says expedited services are going to become the standard in pathology care and that telemedicine has the potential to significantly change the role of mini clinics such as MinuteClinic.

Planting the seed

The program at the university started with a digital mammography trailer created jointly by the Department of Defense and Johns HopkinsGE Imaging (an effort to better serve the breast health needs of women in the Army). The mobile lab prototype was placed on the Tohono O’odham reservation to facilitate healthcare for women on the reservation, who often had difficulty getting test results due to lack of transportation or telephone.

Three hundred miles to the south, the university’s department of radiology had built a broadband telecommunications infrastructure to serve rural areas and prisons. The department agreed to sign out those digital mammograms in less than an hour, so women could get their reports before they left the [mobile] clinic,” said Weinstein.

The experiment was a stunning success. Weinstein said. More than 6,000 cases have been handled so far, 75% of the women get their written report within 45 minutes, and two more sites have been set up on the reservation. “That was what planted the seed that we could do a lot of women’s healthcare in a single day,” he said. “It’s changed the standard of care for women’s breast care on the Navajo reservation.”

The next logical step was to see if rapid tissue processing and telepathology could be used to decrease the time patients waited for biopsy results, said Weinstein. The step after that was to see if women diagnosed with cancer could see an oncologist the same day, either within the facility or via teleconference. Today, this is being done successfully at The Tucson Breast Cancer, which Weinstein said handles about 30 cases a month and plans to increase volume.

Taking shape

Since faculty at the university are encouraged to spin off companies as part of technology transfer, Weinstein founded UltraClinics, based in Phoenix. The fledgling for-profit company holds the intellectual property for the technology (called virtual slide telepathology) that allows for rapid diagnostic services for breast and prostate biopsies.

Right now, Weinstein and his partners at UltraClinics are unsure of the new company’s exact role. One possibility is to open and run more mini clinics like the Tucson Breast Center, another is to act as a consultant for healthcare organizations that want to open their own clinics.
One thing Weinstein is sure of is the affect this technology can have on breast and prostate treatment, as well as the potential telemedicine has for mini clinics. “We’ve shown how you can greatly expand the reach of a mini clinic,” he said. “With telemedicine, you can bring physician services into a mini clinic. That’s a paradigm shift.”

There are potential advantages for hospitals, as well, Weinstein said. He explained that rapid tissue processing and digital slides are quickly becoming the standard of care at universities. “We run an outreach program out of my department, so there are days when, for example, the gynecologist is covering a rural community. With this technology, if we have a difficult case, we can digitize a slide in a minute and put it up on a server. He pulls it up on the Internet and gives us his diagnosis. Having a consultant always available makes it possible for a smaller university like ours to have a specialty based pathology service.”

Similarly, telehealth has the potential to change the patient treatment model. “Just as we can bring a pathologist into where the lab is, we can bring an oncologist to where the patient is,” Weinstein said. Rather than having the patient travel to various offices, with the lab associated with each registration, in the not-so-distant future, we may see virtual group practices where the patient stays in one place, and physicians are brought in via a telehealth system.

**Hurdling barriers**

Weinstein said the largest barrier to adoption of these types of systems is IT. “Many times, healthcare systems can’t leverage themselves into these types of activities because they don’t have the skill sets. They frequently don’t have the IT people, and firewalls are always the overriding issue,” he said.

The Arizona Telemedicine Program uses an application service provider model to connect with 55 healthcare organizations all over the Arizona region, including 11 prisons and many smaller providers. “We can provide radiology clinics to a lot of small hospitals that don’t have IT people,” said Weinstein.

Another major challenge is insurance. “So much of insurance, particularly in pathology, is carve outs,” Weinstein said. “For example, for medical care in Arizona, even within our university practice, our patients’ Medicare patients’ samples would be sent to Phoenix to a commercial lab.” He noted that consumer-driven health plans are one solution to this problem. “That’s the only way you’re going to be able to let people make choices.”

Despite the challenges facing this new model, Weinstein is passionate about advancing it. “The majority of phone calls I get are from women who want to know where their breast biopsy report is. The terror in their voice is really moving.”

—All Rose
The S-Curve Framework: Predicting the Future in Anatomic Pathology

Ronald S. Weinstein, M.D., F.C.A.P.
Professor and Head
Department of Pathology
Director
Arizona Telemedicine Program

University of Arizona
College of Medicine
Tucson, AZ

Disclosures: UltraClinics®, DMetrix, Apollo
S-Curve of Innovation

S-CURVE

Performance

Effort (funds)

Thomas W. Lawson 1902
One tends to be over-optimistic in the short run and under-optimistic in the long run, because we can only extrapolate linearly and progress is always an exponential curve.

- Arthur C. Clarke
Telepathology and the Networking of Pathology Diagnostic Services

Ronald S. Weinstein, MD; Kenneth J. Bloom, MD; L. Susan Rozek, RN

Telepathology is the practice of pathology over a long distance. Components of a telepathology system include the following: (1) a remote-controlled light microscope attached to a high-resolution video camera; (2) a pathologist workstation incorporating controls for manipulating the microscope and a high-resolution video monitor; and (3) a telecommunications linkage. An immediate challenge is to establish the specifications for a telepathology system. Breast tissue has served as a model.

Telepathology is defined as the practice of pathology at a distance by visualizing an image on a video monitor rather than viewing a specimen directly through a microscope. Although in its infancy, several trends in laboratory medicine seem to favor the development of telepathology. These include the emergence of centralized reference laboratories, the creation of financial incentives to spin-off certain in-house hospital operations including some laboratory

ments in radiology are applicable to pathology, although the transfer of the technology from one specialty to the other is just beginning to take place. For example, advances in the development of the digitized radiology department and the introduction of teleradiology as an approach to delivering radiology diagnostic services off-site may foretell what could happen to the practice of anatomic pathology in the future. Dramatic improvements in the technology
S-Curve of Innovation

Telepathology/Digital Pathology

No. Sites/No. Cases

2007

Years
S-Curves of Innovation

Telepathology/Digital Pathology

Performance

Effort

Robotic Microscopy

Virtual Microscopy

Discontinuity
Whole slide digital imaging

1999

Virtual slide network

Site #1

Site #2

Site #3

Virtual Slide Processor

Client

Internet
Virtual Slide Image Acquisition

Raster scanning

Single optical axis light microscope
Virtual Slide Telepathology

Fully Digitized Slide → Server

workstation → Telepathology Report
Aperio virtual slide scanner
Aperio virtual slide scanner

Lab Services

Education
What's next?

1987 to 2007
2007 to 2027
## Virtual Slide Digitizer Applications

<table>
<thead>
<tr>
<th>Application</th>
<th>Class 4A(^a) (&gt; 10 min.)</th>
<th>Class 4B (&gt;10 min.)</th>
<th>Class 5A (&gt;10 min.)</th>
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**CAP Foundation**

**Futurescape of Pathology**
Ultra-Rapid Virtual Slide Processor Program

Working Group: Michael R. Descour, Ph.D, Peter Bartels, Ph.D. 
Chen Liang, René Slack, Ph.D., Ronald S. Weinstein, M.D.

Aim: Increase the field-of-view of the light microscope

Deliverable: Miniaturized microscope array digital imaging engine
- Miniaturization
- Array microscope
- Parallel processing
Conventional Optics vs. Array Microscope Optics

(a) Object Plane

(b) Image Plane

Arizona Program
Miniaturized Microscope Array

*Concept rendering*

Weinstein *et al*, Human Pathology, 2001
field-of-view
Invention of the lenslet array ensemble
3 stacked lenslet arrays = 1 lenslet array ensemble
Virtual Slide

Breast core biopsy

Scan time - ~ 1 minute
S-Curves of Innovation

Virtual Microscopy

Performance

Effort

Discontinuity

Single axis LM

Array microscopy
University of Arizona Virtual Slide Applications

College of Medicine
University of Arizona
Tucson, Arizona
Acute Inflammation – Laboratory

Anna R. Graham, M.D.

Wednesday, August 2, 2006

Laboratory Objectives

1. To observe the morphologic changes in tissue with acute inflammation.
2. To identify (when possible) the underlying process which induced the acute inflammation.
3. To recall the cellular events, which produced the microscopic appearance observed (chemotaxis, margination, etc.).
4. To relate the microscopic findings to gross and clinical findings.

Microscopic Slides

Slide #40 (Acute appendicitis): This is a cross-section of an appendix. If you look at it on low power, you can see the mucosal ulceration (discontinuity), which gave rise to the inflammatory response. This is an area where the normal colonic mucosal glands are missing. Something (perhaps a hard fragment of stool termed a fecolith) injured the mucosa and allowed the bacterial flora of the gut access to the underlying connective tissue of the appendix wall. Notice the sea of white blood cells (granulocytes) around the...
Virtual Slides in Diagnostic Pathology at the University of Arizona

DMetrix Virtual Slides
Same-day Breast Care Services

• “One stop shopping”

• Telemedicine-enabled

• Ultra-rapid labs and radiology services

• On-line second opinions
13,000 take a swing at breast cancer

KATE G. STEVENS kates@tucsoncitizen.com

Pink was everyone’s favorite color Sunday at the ninth annual Southern Arizona Race for the Cure.

More than 13,000 people—men dressed in pink skirts, dogs in pink vests and women in pink wigs—attended the event, raising nearly $1 million. “It actually shows me that when your mom dies of breast cancer,” said Northwest Hospital nurse Beth Robbaker, who walked for the cure.

Robbaker’s mother died in 1990 after six years of treatment. “I have to say that it doesn’t really ever get easier,” Robbaker said, as her eyes welled up with tears. “She never got to see me graduate.”
“Patients Vote With Their Feet”
Thank you!

Ronald S. Weinstein, M.D.

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