

# USC's Clive Taylor, MD, Talks Digital Path, WSI

➤ Noted pathologist shares insights, predictions into how this technology may disrupt pathology

**» CEO SUMMARY:** *The FDA's clearance of the first digital pathology system for use in primary diagnosis will be a disruptive force for pathologists in the coming years. At the University of Southern California Keck School of Medicine, pathologist Clive Taylor, MD, predicts that the benefits of whole slide imaging and digital pathology will enable pathologists to cut the time to diagnosis and allow them to offer enhanced diagnostic services that contribute to improved patient care.*

IN THE WAKE OF THE FDA'S CLEARANCE of whole slide imaging for primary diagnosis of biopsied tissue, digital pathology has become a key strategic issue for all pathologists. The question is no longer "should we buy a digital pathology system?" Rather, it is "When should we invest in digital pathology and whole slide imaging?"

To help pathologists answer this question, THE DARK REPORT turned to Clive Taylor, MD, PhD, a professor of pathology at the **Keck School of Medicine at the University of Southern California** (where he served as Chair of Pathology from 1984 to 2009).

Taylor is one of the esteemed leaders in the field, not just in the United States, but around the world. He offered keen insights into how digital pathology can be disruptive, along with several bold predictions of interest to pathologists in academic or community settings.

"April's FDA clearance of the **Philips IntelliSite Pathology Solution (PIPS)** for primary diagnosis is significant for many reasons," commented Taylor. "PIPS is the

first whole slide imaging (WSI) system to pass the FDA's regulatory hurdles for reviewing and interpreting digital pathology slides prepared from biopsied and resected tissue.

"The FDA's clearance of this system for primary diagnosis is huge," he continued. "It could have been any vendor, but Philips got there first, and just the fact that it's now approved will break a log jam."

## ➤ Digital Scanners

"I say that because digital slide scanners in many pathology departments around the country are used secondarily," he explained. "For example, a pathologist will look at a glass biopsy slide today and think, 'I should scan this to get a score, or an accurate count, or to send it to a colleague in Washington or London or some place.' In that sense, pathology labs are using whole slide imaging for secondary purposes."

"The FDA clearance of whole slide imaging for primary diagnostics will foster changes in anatomic pathology departments that will improve the accuracy and

speed of diagnosis and drastically reduce the time it takes to get second opinions and to reach a primary diagnosis," Taylor predicted.

"Now that whole slide images can be used for primary diagnosis, we will start to integrate them into the diagnostic process, beginning with conferences and shared consultations with colleagues," he noted. "In some pathology departments, in less than three years we can expect to see digital pathology systems used for most primary diagnosis. But it may take as long as 10 or more years in other pathology departments.

## ➤ More Images, Fewer Slides

"Eventually, histology labs will send only digital files (WSIs) to pathologists, and glass slides will no longer be sent unless pathologists ask for them specifically—usually when they have a case that is difficult to interpret and they seek the comfort of glass slides to which they are accustomed," offered Taylor. "But as digital experience grows, recourse to glass slides will diminish, because much more can be achieved with a digital image.



Clive Taylor

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"Having said that, digital imaging will definitely produce some workflow changes very soon," Taylor added. "Right now, everything in anatomic pathology departments hinges on the histology lab which starts its work early in the morning. That's when it removes specimens from the overnight batch processors and begins slide cutting and staining runs.

"Only after all batches are complete does the histology lab release the glass slides to the pathologists, who may be in a distant office or even a different building," he said. "The pathologists can't do their

daily sign-outs until the slides arrive. And they usually arrive in batches of 100 or more slides.

"There will be significant workflow advantages from switching to a digital system," he stated. "As glass slides come off the staining runs, they will feed into the scanner and the barcode will send the whole slide images immediately to the appropriate pathologist. As that happens, the pathologist will be notified on his or her laptop, phone, or desktop that there are cases to review.

"This will dramatically cut the time that pathologists wait for batches of slides," said Taylor. "Once a pathology group goes digital, it can feed glass slides into the scanner immediately after the staining is finished in a continuous production mode.

"Case-by-case, as the whole slide images emerge from the scanner, bar-coding lab systems will allow them to be distributed automatically to the specified pathologists on service or to the subspecialist for each particular case," added Taylor. "The system will ping the pathologist that a case is ready for sign out. Not having to wait for the whole batch will speed things up significantly."

"Another benefit of WSI will be the ability to use computer-guided algorithms. Because we'll be using digital images and not glass slides, pathologists can get assisted diagnosis easily," he explained. "This already happens in radiology where a CT scan is computer reviewed against previous scans. That computer review draws the radiologist's attention to certain areas. WSIs will allow a similar thing to happen in pathology."

Taylor has another unusual prediction. He believes the profession of pathology will benefit from an explosion of apps. "Think of how apps have been developed for the iPhone or other smart phones," he observed.

"This spring, Silicon Valley celebrated the 10th birthday of the iPhone and it

struck me that just 10 years ago, the iPhone had about five or six apps when it came out," he stated. "Now there are 2 million.

## ► Millions of Digital Path Apps?

"That's what happens when you give smart people digital files with which to work," continued Taylor. "To be sure, there won't be 2 million apps in pathology but I would bet that, within five years, there'll be 1,000.

"The reason I say that is because digital files lend themselves to so much analysis," he added. "For example, think about how we use Google Maps to find restaurants in an unfamiliar town. We will apply similar technology to digital slides, allowing pathologists to instruct systems to show us the nearest cancer cells in an unknown tissue section. In fact, this technology already exists through machine learning. It will just take time for it to become a normal part of pathology practice.

"Another way to look at what will happen is to examine how digital imaging changed radiology," Taylor suggested. "Radiology had intrinsic advantages and lots of cost savings by doing away with hard radiology films and the use of silver salts.

## ► More Efficiency Coming

"Subsequently, time and motion studies showed that fewer radiologists were doing the work that more radiologists did previously," observed Taylor. "The workload has gone up, but the number of radiologists has not. Some say that five radiologists now do what 6 or 7 did previously. I'm sure a similar trend will happen in pathology.

"In most pathology practices today, we spend a substantial amount of time sorting, delivering, and looking for glass slides and the matching paperwork," Taylor said. "Lab information systems already exist such that when they are applied to digital WSI files this problem will almost entirely disappear.

"Another problem that digital files will solve for us is the time it takes to get an internal second opinion with glass slides," he added. "To share a case today, you have to find your colleague, walk down the hallway, show the slide, wait while your colleague looks at it, and then walk back and change the report. That's 20 minutes gone. Digitally you could do the whole secondary review in 5 minutes.

"Also it is generally agreed that sharing a slide improves the quality of the diagnostic process," he said. "If you want to show an image to a subspecialist in your department, you would be able to do so with the press of a button.



Clive Taylor

► I believe that digital pathology and whole slide imaging will improve the accuracy and speed of diagnosis.

"The same will be true for the ability to share images with an expert at the **National Cancer Institute**, for example," Taylor added. "Getting a review from someone at NCI could take a week or more now, but it might take only minutes in the coming years.

"For all these reasons, I believe digital pathology and whole slide imaging will improve the accuracy and speed of diagnosis," he concluded. "All of those things will change the practice of pathology.

"It will be the biggest change in 180 years, since the introduction of the microscope itself," Taylor predicted. "And the cost savings will have to come from improvements in logistics and productivity of technologists and pathologists because, unlike in radiology, we won't save money on silver salts used in developing radiology film."

**TDR**

—Joseph Burns

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