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Machine learning: What will it do for pathology?

If finance, online retail, and other industries are “embracing” machine learning, then the medical field is still in the polite handshake phase, despite the potential of this form of artificial intelligence to revolutionize health care. Recent research endeavors highlight just a few examples of what machine learning, which allows computers to analyze data, detect patterns, and build algorithms to guide decision-making, can contribute to the field of pathology alone. At Case Western Reserve University, for example, a deep-learning computer network analyzed 200 whole slide images from biopsies and determined whether invasive breast cancer was present or absent with 100 percent accuracy. In a Stanford University School of Medicine study, a machine-learning approach was used to assess thousands of characteristics of nearly 2,500 whole slide images, accurately differentiate between lung adenocarcinoma and squamous cell carcinoma, and distinguish shorter-term from longer-term survivors in the latter groups. And pathologists at Harvard Medical School employed machine learning to build a decision-support tool that indicates whether a particular molecular variant in cancer should be included in the final pathology report.

CAP TODAY writer Jan Bowers asked four experts to share their thoughts about the use of machine learning in the realm of pathology. Here’s what they said.

How is machine learning influencing the practice of pathology today?

Dr. Madabhushi

Anant Madabhushi, PhD, professor of biomedical engineering, Case Western Reserve University: I don’t think machine learning is at the point where it is directly influencing pathology just yet, but that will soon change. The recent FDA allowance for the marketing of digital slide scanners for primary diagnosis was a major inflection point for the field. This means that a lot more labs are going to want to adopt digital pathology solutions. Machine learning will come slightly later. Once that digital system has been put in place and the kinks have been worked out, then you can get into machine learning and automated interpretation.

Jochen Lennerz, MD, PhD, assistant professor of pathology, Harvard Medical School: Machine learning is

having too little impact on pathology. There's tremendous potential there for having a positive influence, but I think that for many pathologists, the prospect of embracing machine learning is, at first glance, daunting. It's perceived as computer scientists invading our space, which I don't think is the case.

Michael Snyder, PhD, professor and chair of genetics, Stanford University School of Medicine: Before machine learning can truly influence the practice of pathology, two things have to happen: We have to show that what we do works, and then let pathologists try it out.

In what ways will machine learning benefit the practice of pathology in the future?

Dr. Lennerz

Dr. Lennerz (Harvard Medical School): Machine learning is one of the pivotal tools that will help us make sense of big data. For example, the decision-support tool that we [Harvard] built captured the collective sign-out experience of six molecular pathologists. The model was based on about 20,000 molecular variants that we've encountered for almost 300 different cancers. Each variant, if it were expressed in table format, would have 500 columns of data associated with it—from what chromosome the gene is on, to predicted functional consequences of the encoded amino acid change, etc. That ability to exploit vast amounts of data will have enormous benefit for pathology. In order to change practice, pathologists need to identify truly valuable, cost-efficient use cases that can be argued as better than the current standard. We now have to show that we can use machine learning to change outcomes, change clinical management, and add value in our current practice.

Dr. Madabhushi (Case Western Reserve University): Algorithms such as the ones that our group are developing will have an impact on the practice of pathology. If the machine algorithms can tell which patients have cancer and which do not, this technology can serve as triage for pathologists, freeing their time to concentrate on the cancer patients. In addition, the algorithms can rank order the slides in terms of degree of suspicion so that the pathologist can focus on the tougher cases first. The easier cases might just get triaged, and the pathologist may not end up seeing them at all.

There's a lot that's still evolving in terms of which applications and in what particular context machine learning is going to add value. The mining of subvisual images, features that may not be visually discernible by a pathologist, will provide confirmation value to what the pathologist can see from the slide. The question is, what is the use here? How does it simplify my job? Those answers have not really crystallized. I think that once that's articulated, then you'll have off-the-shelf solutions to address those needs.

Dr. Snyder (Stanford University School of Medicine): I think that eventually everything will be analyzed using software generated from machine learning. Right now, it's very subjective—if two pathologists look at the same tissue section in the cancer space, they typically agree about 60 percent of the time. When the software analyzes a section, that takes the subjectivity out, so the results should be much more accurate and more reproducible. In addition, it should definitely improve throughput and workflow and reduce costs—you've got a machine looking at thousands of patient samples in a matter of minutes. Even if the pathologist reviews the final results after image processing, the amount of time it takes overall will be much less because the pathologist will simply be concurring or not concurring. I'm very optimistic that this is the future.

Daniel L. Rubin, MD, director of biomedical informatics, Stanford Cancer Institute: I believe that, as in radiology, certain applications will find a place in pathology—for example, those that accelerate workflow, prioritize cases for interpretation and reporting, and detect regions of abnormality. In the long term, I think machine learning

will catalyze a closer relationship, and perhaps even convergence, of radiology and pathology . . . given their need for integrating information from multiple modalities, which is greatly aided by machine learning.

Will machine learning complement or supplant the work of pathologists in the future?

Dr. Madabhushi (Case Western Reserve University): I'm inclined to say that it will complement the work of the pathologist. Deep-learning networks such as the ones developed by our group and others are really good at identifying the cancers, but it will take time to match the 20 years of practice and training a pathologist draws upon to identify complex cases and mimics, such as adenosis. Obviously the networks can be trained to recognize these more confounding cases, but I see the short- to medium-term impact being in the triaging of cases and reducing workloads and improving efficiencies, as opposed to outright displacement of pathologists.

Dr. Lennerz (Harvard Medical School): I view machine learning as a tool that will complement pathologists and add to their skill set. If you are a pathologist in 10 years, you will be expected to know what your [patient] data mean when compared to that of similar patients and in the context of integrated, large-scale worldwide consortiums. This will require the adoption of machine learning and other artificial intelligence tools. It can make your daily life better, make you more effective. If you don't perceive it as an alien attack, you have the chance to change the field that you love. I think that's an incredible opportunity.

Dr. Snyder

Dr. Snyder (Stanford University School of Medicine): The pathologist won't go away because someone will need to review the results. In making the most important medical decisions, you want to have enough safeguards. My first impulse was to say that there might be fewer pathologists needed, but the reality is the workload never seems to go away. There's a lot of interest in tumor heterogeneity these days, so if the throughput is higher, we'll have more time to look at multiple sections from the same tumor.

Dr. Rubin

Dr. Rubin (Stanford Cancer Institute): I don't believe machine learning will supplant or replace physicians, nor is that the goal. It's all about physician enablement. The companies that make these products . . . are not licensed to practice medicine. Physicians will be the consumers of this technology, and reductions in practice variation and more precise treatments based on patient characteristics will be the beneficial result.

IICC introduces specification for IVD test results

The IVD Industry Connectivity Consortium has announced the release of the LIVD specification for digital publication of LOINC for vendor-defined in vitro diagnostic test results in clinical laboratories.

"LIVD assures that laboratory personnel select the appropriate LOINC codes for vendor IVD test results used by

their laboratory," Ed Heierman, chief technology officer for the IVD Industry Connectivity Consortium, said in a press release. LIVD also allows lab information systems to automatically map the correct vendor IVD test result to a LOINC code, he added.

The LIVD specification outlines an IVD industry-defined format to facilitate the publication and exchange of LOINC codes for IVD test results based on vendors' IVD test transmission codes or manual test identification. It can be used by laboratorians or lab applications.

"Development of this new common format for publishing mappings from IVD vendor test results to LOINC codes is a major advance for [the] interoperability of laboratory data," Daniel J. Vreeman, DPT, director of LOINC and health data standards at the Regenstrief Center for Biomedical Informatics, said in the press release. "As IVD vendors make such mappings available, it will greatly improve the efficiency and consistency with which laboratories can deploy standard terminology in their information systems."

Seacoast updates lab systems

Seacoast Laboratory Data Systems has released new versions of its SurroundLab Plus laboratory information system and SurroundLab AR lab billing solution.

Among the enhancements to SurroundLab Plus is support for Internet-based faxing, including a newly designed fax monitor; reflex testing rules updates, as well as the ability to print a barcoded label when the reflex occurs and reflex by payer; and improvements to the ask-at-order-entry process, such as new picklist options.

The latest release of SurroundLab AR features edit options for ICD by payer settings; invalid primary diagnosis settings; the ability to copy National Correct Coding Initiative, or CCI, definitions; and enhancements to the functionality for loading fee schedules, such as the option to update only select fields for an existing schedule.

Both lab systems are now available via a browser-based user interface, as well as via terminal emulation.

***Seacoast Laboratory Data Systems**, 603-431-4114 ext. 6220*

Website links researchers to human biospecimens

The company iSpecimen has launched iSpecimen Marketplace, an online platform that connects life science researchers seeking human biospecimens with health care organizations that have such specimens.

The iSpecimen Marketplace can be used to access de-identified electronic medical record and laboratory data from a network of pathology labs, biobanks, blood centers, and other health care institutions. The technology "aggregates a vast amount of information about individual specimens and the patients from whom they came into a single, harmonized view," the company reports. "Researchers can quickly and easily search this data using detailed patient, specimen, and compliance criteria and instantly view the availability and details of specimens that meet their specific needs. Contracting is likewise simplified and accelerated, as researchers and providers alike contract once with iSpecimen and gain access to all other organizations in the network."

The iSpecimen Marketplace offers access to nearly one million biobank specimens, including biofluids, tissue, and cells. As part of a phased approach, the company expects to add millions of clinical remnants to the platform this summer, as well as add, by the end of the year, research-use-only samples collected prospectively.

"Additional features of the iSpecimen Marketplace include automated fulfillment and procurement processes, offering a partner-facing Web interface that directs specimen selection, packing, and shipping," according to a press release from the company. "Further, as a benefit of participation, iSpecimen partners can use the technology to gain insight into their own specimen availability as well as access specimens from across the network for their own internal research needs."

***iSpecimen**, 781-301-6700*

HHS releases cybersecurity quick-response guide

The Department of Health and Human Services, Office of Civil Rights, has published a quick-response checklist for addressing ransomware attacks and other cybersecurity incidents.

The checklist, and an accompanying infographic, detail steps that a HIPAA-covered entity and its business associates should take to respond to a cyber attack or similar emergency. It includes such information as when, how, and where such breaches should be reported.

The reference guide and infographic can be downloaded from the HHS website.
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