Pathologists (CAP) and employs checklists to improve reporting in surgical pathology. The CAP provides these checklists as written documents in both Microsoft Word (Microsoft Corporation) and PDF format, as well as a set of XML files for use with the electronic Cancer Checklist (eCC). However, the value of checklists extends beyond the specific content defined by CAP; checklists can aid in ancillary test ordering and billing compliance, and sites may make local customizations to satisfy their clinicians. Although the CAP provides a list of optional questions in their products, the use of a noncustomizable list of optional elements leads to incomplete and inconsistent reporting. As a result, the use of the CAP-provided products without customizations fails to fulfill the potential of checklists to improve patient care.

We have been using a Web-based product with extensive customizations for nearly 2 years. Even with our reflex ancillary studies rapidly changing, this site has kept a widely dispersed group of pathologists on the same standard while incorporating customized questions, customized formats to improve the speed and accuracy of data extraction by the clinician from the report, billing data, ancillary studies, and additional instructions on the site for the pathologist (including staging criteria and immunohistochemical evaluation) that do not appear on the report. This has led to significantly improved reporting performance for our group as well as others who use similar methods. Prior to these customizations, 2.1% (32 of 1043) of cases with synoptic reports had addendums with additional clinical information requested by the clinicians. After the inclusion of these additional customized questions, only 0.08% (3 of 3973) of cases with synoptic reports had addendums for additional requested information (Fisher exact test, $P < .001$). Each of these addendums represents an unnecessary phone call, and this likely underrepresents the true incidence, because only cases with addendums were included.

Despite these advantages, most pathologists are reluctant to customize their synoptic reports because updating these CAP products is extremely burdensome, and the updates usually override and remove any customizations. Although CAP releases a set of paper documents and XML files for each update, by design these products must replace rather than integrate with what pathologists are already using, and local pathologists, not the CAP, are responsible for incorporating and maintaining updates. This entails either significant manual effort to edit written local versions of these documents, or working with the local Information Technology departments and the particular vendor of the eCC. Given that CAP considers the protocols “living documents that get updated...not infrequently,” it is no surprise that many sites are unwilling to devote any additional resources to customize their checklists above and beyond what they already must do to simply keep them updated. Indeed, as a manager from Epic Corporation has said in CAP Today, “customization comes with a big maintenance burden...shouldn’t be taken lightly...and you [the local pathologist] will have to figure out who is responsible for making sure the new forms...are maintained.”

Fortunately, it does not have to be this way. There is no technical reason that updates need to delete all customizations. In 2018, Web-based tools can easily solve this problem and are usually taken for granted. No one loses his or her customized contact list simply because his or her cell phone operating system is updated. Pathologists, who are quick to not only embrace but demand the latest molecular techniques for their patients’ care, should do the same for their synthetic reporting. A Web-based product that includes either a Web site with local pathologist access, an application programming interface that works with specific vendor laboratory information systems or the local pathologist’s Web site, or a combination of these options would solve this problem. This would allow sites to easily maintain customized question and answer sets during the update process. The CAP should be responsible for keeping the required elements up to date and available in a method that local pathologists can easily integrate into whatever method they are already using, local pathologists should be responsible for customizing it to meet their local needs, and updates and customizations should not interfere with each other. Unleashing the full potential of checklists by incorporating Web-based technology would be a clear “win-win-win” for pathologists, clinicians, patients, and the CAP.

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In Reply.—The electronic cancer checklists (eCCs) produced by the College of American Pathologists (CAP) enable pathologists to complete the synoptic report within the routine workflow of the anatomic pathology laboratory information system (AP-LIS), and most AP-LIS vendors offer an eCC synoptic reporting module. About one-third of eCC users customize their synoptics by including additional data elements that local pathologists or clinicians want in their reports. These customizations can align the synoptic report with individual practices and help improve report completeness, but also add complexity and work for the pathology department. As noted by Renshaw and Gould, these locally determined elements are not included in protocol or eCC updates and therefore must be
redone every time a protocol is updated.

The CAP has introduced several initiatives to assist laboratories in minimizing and maintaining customizations. As we described in a previous editorial,\(^1\) we have been working to reduce the burden of data entry by simplifying question-answer sets and have attempted to include elements that decrease the need for customizations. We have also introduced an eCC XML comparator, which is a browser-based tool that allows users to compare versions of eCC XML templates. The tool reads the eCC XML files and enables users to identify all content and metadata changes from one release to the next. We are currently discussing with AP-LIS vendors the best way to incorporate this tool into their update processes. Unfortunately, as these solutions tend to be resource-intensive, vendors are reluctant to spend time and money if demand is low.

The CAP’s professional staff and committee members have been working closely with the AP-LIS vendors for several years but have not yet found a simple method of solving the customization update issue. Renshaw and Gould state that Web-based tools can easily solve the problem of lost customizations, but they do not identify such tools or describe how they would work for most laboratories that use eCC within their AP-LIS. We are very interested to learn how their Web-based method works and welcome open dialogue with them, but if the customization tools are designed for a homemade system, they may not be applicable to eCC templates integrated directly into vendor systems in most pathology departments. We would point out that Renshaw and Gould’s analogy of customized cell phone contact lists being retained when the operating system is updated is not an accurate comparison with eCC updates. Everyone with an iPhone or an Android phone uses the same operating system, but this is not the case with laboratory information systems.

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Open-Source Whole Slide Image Preparation and Viewing Pipeline

To the Editor.—Whole slide imaging (WSI) of pathology slides for education provides several benefits, including consistency and durability of materials, simultaneous viewing by physically distant users, and the ability to access materials in situations or locations not amenable to traditional microscopic viewing. Despite these benefits, the adoption of WSI in education has been slowed by the technical complexity and expense of WSI systems, existing incompatibilities between scanners, viewers, and institutional computing platforms, and a dearth of WSI applications designed for educational content. These problems have begun to be addressed by a number of proprietary cloud-based platforms, but those solutions often come with image sharing requirements or associated costs. Herein, we describe an open-source WSI preparation and viewing pipeline that addresses concerns of cost while maintaining compatibility between a wide variety of scanning and viewing devices. This technology is currently used for educational applications at multiple levels, including undergraduate medical education, pathology training programs, and continuing medical education offerings.

Briefly, this WSI pipeline uses open-source software for conversion (libvips [https://jcupitt.github.io/libvips/] and OpenSlide [https://openslide.org]), storage (Deep Zoom specification, Microsoft, Redmond, Washington; http://msdn.microsoft.com/en-us/library/cc645050(VS.95).aspx), and viewing (OpenSeadragon; https://openseadragon.github.io). Using libvips and OpenSlide, whole slide images are converted from a proprietary format into the Deep Zoom image format, which is an XML specification including a small XML document and a subdirectory containing JPEG-encoded image tiles. Using the OpenSeadragon JavaScript library (or other compatible viewers), the virtual slides are rendered for viewing in any modern Web browser (eg, Chrome, Safari) on any platform (eg, Windows, Macintosh, Linux) or device (eg, laptop, tablet, or mobile phone). For educational uses, associated images or contextual clinical information can easily be added in a simple HTML Web page. We generate templated Web pages on a weekly basis for our resident unknown slide conferences using an automated Jekyll static site generator that converts human readable markdown syntax (.md) into an HTML5-compliant mobile-responsive Web page. The infrastructure requirements for this pipeline are modest; the entire system is currently hosted on a 2010 iMac computer (Apple Inc, Cupertino, California). In a survey of our pathology trainees, the speed, image quality, and ease of use of this browser-based viewer were highly rated and compared favorably with proprietary viewers.

Virtual slides generated using this pipeline are easily shared using cloud storage services, removing local infrastructure requirements and allowing for global distribution of images. We have had great success using this infrastructure to transfer images to international servers, maximizing performance for end users. In our implementation, we perform slide deidentification and image processing locally, and then upload image tiles and HTML files to a cloud storage provider offering Web-based file access. Cloud-based whole slide images can be presented to end users either through a stand-alone Web page or embedded in any secondary platform that accesses Web-based content (eg, Blackboard Learn, Blackboard Inc, Washington, DC). Cloud-based storage using static files provides an infrastructure-free alternative to proprietary cloud solutions and can be implemented with few technical requirements and low initial and ongoing costs. Instructions for implementing this pipeline and examples are available at https://github.com/AndrewNorgan/wsi.

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