Web-based synoptic reporting for cancer checklists

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Abstract

Background: The surgical pathology report remains the primary source for information to guide the treatment of patients with cancer. Failure to report critical elements in a cancer report is an increasing problem in pathology because of the heightened complexity of these reports and number of elements that are important for patient care. The American College of Surgeons Commission on Cancer (ACS-CoC) in concert with the College of American Pathologists (CAP) developed checklists that contain all of the scientifically validated data elements that are to be reported for cancer specimens. Most institutions do not as of yet have pathology information systems in which CAP checklists are embedded into the laboratory information system (LIS). Entering the required elements often requires extensive text editing, secretarial support and deletion of extraneous elements that can be an arduous task.

Materials and Methods: We sought to develop a web-based system that was available throughout the workstations in our department and was capable of generating synoptic reports based on the CAP guidelines. The program was written in a manner that allowed automatic generation of the web-based checklists through a parsing algorithm.

Results: Multiple web-based synoptic report generators have been developed to encompass required elements of cancer synoptic reports as required by the ACS-CoC/CAP. In addition, utilizing the same program, report generators for certain molecular tests (KRAS mutation) and FISH studies (UroVysion™) have also been developed. The output of these reports can be cut-and-pasted into any text-based anatomic pathology LIS. In addition, the elements can be compiled in a database.

Conclusions: We describe a simple method to automate the development of web-based synoptic reports that can be entered into the anatomic pathology LIS and database.

Key words: Cancer registry, cancer report template, cancer checklists, synoptic reporting, tumor reporting

INTRODUCTION

Surgical pathology cancer reports are meant to report all pathologic information relevant to the treatment of the patient, such as type of tumor, status of margins and submitted lymph nodes. However, the amount of information required has grown dramatically and as a result, essential elements are often lacking in reports,[1] and there is significant variation in reporting terminology and presentation of the data among different pathologists.[2,3]

In an attempt to remedy this situation, proposals were
presented to develop a synoptic style of reporting for cancer specimens to increase efficiency and ensure uniform reports that contained all pertinent data. The American College of Surgeons Commission on Cancer (ACS-CoC) seized on the importance of synoptic reporting and mandated that pathology reports at the roughly 1,400 ACS-CoC accredited cancer hospitals contain all of the scientifically validated data elements. To comply with this mandate the College of American Pathologists (CAP) has developed site-specific cancer reporting checklists that are continuously updated and available at the CAP website.

The use of the CAP checklists for cancer reporting has significantly reduced omissions and improved consistency. These are currently provided in either a Microsoft® Word® based document (.doc) or a portable document file (.pdf) format. Both of these formats require significant intermediate steps in order to generate a final synoptic report. For instance, if the checklists are simply cut-and-pasted from the word document a significant number of unused choices must be deleted. If the checklists are printed out and the elements are dictated, significant work must be performed by transcriptionists in order to render the final report. The least desirable option would be printing out a copy of the checklist, noting the required elements by checking the appropriate boxes or filling in the data field, and then submitting that to the patient’s chart where it may or may not be scanned into the patient’s clinical record.

We sought to develop a web-based system for generating cancer reports that required minimal text entry and editing and could be entered into the anatomic pathology LIS via a simple cut-and-paste operation. Furthermore, our goal was to create a system that would allow for the automated generation of web-based reports for each of the site-specific cancer checklists since the current number of these checklists is quite large (currently 64 CAP checklists exist). An additional benefit to such a system is that it provides an easy mechanism to allow entry of the pathologic elements into a searchable database.

**METHODS**

Our institution currently employs synoptic cancer-based reporting for a number of anatomic specimen sites based on the CAP checklists. These Microsoft Word®-based documents were modified to include descriptors of the needed web elements, including radio buttons for mutually exclusive choices (for example, the type of tumor could be selected from a given list); checkboxes for elements that might contain multiple choices (for example, location of positive margins); and text box entry for free entry items such as tumor size [Figure 1]. An

![Figure 1: Template. This template file is read by the parsing program. Descriptors of web elements have been added for parsing purposes](http://www.jpathinformatics.org/content/2/1/16)
algorithm was written in the PHP Hypertext Processor language [Figure 2] to parse the documents for these descriptors and generate a Structured Query Language (SQL) command to create the database, an HTML form for entry, and a PHP file to generate the report and fill the database with the case information after review by the user [Figure 4].

In brief, the algorithm parses the text template [Figure 1] line by line and looks for the key descriptors. If “radio” or “checkboxlist” is found, the lines following it are parsed to obtain the choices. The parse function is run on each line in order to recursively deal with nested lists, and it will appropriately increase indentation with each tier. If “box” is found, a text box is inserted. Text in square brackets is considered a comment to appear in the web form for the pathologist but not in the final report. Curly brackets after a descriptor (radio{}, checkboxlist{}, box{}) indicate that a database entry should be made for this item. The database name is either the text within the brackets or, if empty, the text to the left of the descriptor. The database entry is made in the PHP file
that reads the results of the web form. Pseudocode for the algorithm is given in [Figure 2].

Additional algorithms were added as needed. For example, an algorithm was developed that automatically calculates the S (serum) stage for testicular tumors based on the values of lactate dehydrogenase (LDH), alpha-fetoprotein (AFP) and human chorionic gonadotropin.

A separate page was written for database query using standard SQL commands, generally searching for field contains value. The interface is enabled for autocompletion with Asynchronous Javascript and XML (AJAX), such that as the user types the field they can see all fields containing the typed characters and choose one [Figure 5], and as the user types the value, the database is queried for all values containing the typed characters for that field [Figure 6]. This helps to eliminate unsuccessful searches that will not actually find what the user is looking for. Results are then returned in a table [Figure 7].

RESULTS

The synoptic reporting system is available on the Internet.[12] This public version does not have databasing capabilities. At present, 31 synoptic report generators are available, mostly for cancer-based synoptic reporting. Additional forms have also been generated for KRAS mutation reporting results, UroVysion™ FISH reports and bone marrow biopsy and aspirate reports.

The web-based method allows access to the synoptic report elements at any computer workstation. An appropriate template is selected from a list on the main page. Once opened the synoptic report generator will display all options for elements in the final pathology report. After the appropriate selections are made, the pathologist enters the submit button, which generates a formatted report that omits all of the non-selected elements and adds basic formatting such as tab delimiting. If an error is noted at this stage (for example, the wrong checkbox was selected), the user can use the browser’s back button to make the necessary change and re-submit the report. The HTML page that is generated can then be viewed before the text is cut and pasted into the Microsoft® Word® based text editor for our anatomic pathology information system (PowerPath® Elekta Software).

The output from this system can simultaneously be saved into a database that contains all of the entered elements and is searchable using standard SQL commands.
DISCUSSION

We have developed a web-based synoptic reporting system that we believe has several advantages over traditional dictated or manually entered reporting. First, by using radio buttons or checkboxes, we minimize the amount of typing necessary for generating the final pathology report. This significantly reduces typographical errors and standardizes the reporting language among pathologists, thus minimizing potential misunderstanding in cancer reporting.

Second, since the system allows simple cut-and-pasting into any text-based anatomic pathology LIS, the amount of transcription and associated errors is minimized. If, for example, one were to print out the checklist elements, manually fill them in and then submit these for transcription, this would introduce multiple additional steps in which an error could take place. In addition, the pathologist would still have to closely review all of the elements in the report to make sure that they agreed with those submitted.

Third, since the system is web-based it can be accessed at any computer workstation so no special software is required. This system is compatible with all major internet browsers, including Internet Explorer version 8 (Microsoft Corporation, Redmond, WA); Firefox version 3.6 (Mozilla, Mountain View, CA); Google Chrome version 8 (Google, Mountain View, CA); Safari 5 (Apple, Cupertino, CA); and Opera 11 (Opera Software, Oslo, Norway).

Fourth, this system allows seamless databasing of elements and does not require an additional step to enter the elements in the database. The presence on the web does present possible personal health information issues, but the database is stored on our secure departmental server, can be accessed only with a login, and includes accession number but no other identifiable information. There is some redundancy in that we have the information stored in both the pathology laboratory information system (LIS) and in this database. Presently, our separate database system allows specific queries of each individual reported field, while our primary LIS does
Having two separate systems does allow for some potential discrepancies should the user modify the report before saving it in the main system.

The output of this system is compatible with any anatomic pathology LIS that utilizes a text editor. Many of the newer versions of the anatomic pathology LIS have the option of directly embedding synoptic cancer reports based on the CAP checklists. Ideally, this would also be linked to the patient clinical, laboratory and radiologic data in the hospital wide LIS; such a system would be particularly advantageous for clinical research and outcomes based research. There are advantages, however, to having a standalone system. Principal among these is that our system is very flexible and can be readily changed or adapted to suit the needs of a particular institution. Also, the update of these checklists can be readily achieved by modifications to the text-based template from which the web code is generated. One particular advantage of the system we developed is that it can quickly convert a Microsoft® Word® or other text-based document into a web-based synoptic checklist by automating the generation of the code for the web form.

One weakness is that using these checklists requires the extra step of switching to our system, then copying the results to the original pathology information system. For systems in which synoptic checklists are embedded within the anatomic pathology LIS, this system in built in. For a Microsoft® Word®-based system, macros could conceivably be developed to open the browser to a requested checklist and retrieve the results.

Though not the primary goal during the initial development of this system, it became apparent that the system could easily be adapted for synoptic reporting in non-cancer specimens and non-anatomic pathology specimens. For example, we employ this system for reporting KRAS mutations and have begun using it for reporting UroVysion™ FISH results. We have begun developing simplified synoptic style reports for our hematopathology specimens, in particular bone marrow biopsy and aspirate reports and flow cytometry reporting. In addition, this system is ideal to insert certain “canned” comments.

In summary, the main advantages of this system are ease of creation and alteration of checklists, and the ability to use them at any workstation and with any text-based pathology information system. The main drawback is the lack of unification with the main system and the need to switch between the two.

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