Preferences for Structured Reporting of Measurement Data:

An Institutional Survey of Medical Oncologists, Oncology Registrars, and Radiologists

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Rationale and Objectives: The aim of this study was to determine whether key radiology report "consumers" in our institution prefer structured measurement reporting in a dedicated report section over the current practice of embedding measurements throughout the "Findings" section, given the availability of new tools for quantitative imaging interpretation that enable automated structured reporting of measurement data.

Materials and Methods: Oncologic clinicians and radiologists at our institution were surveyed regarding their preferences for a standard report versus three reports each having uniquely formatted dedicated "Measurements" sections and regarding their impressions of various characteristics of report quality demonstrated by these reports. The online survey was completed by 25 radiologists, 16 oncologists, and 17 oncology nurses and research assistants (registrars).

Results: Aggregation of respondents' preferences by group into single orderings using the Kemeny–Young method revealed that both oncology groups preferred all proposed reports to the standard report but that radiologists only preferred two of the proposed reports to the standard report. All preferences for proposed reports in the two oncology groups were statistically significant based on Wilcoxon tests, but the preference for only one of the proposed reports was significant for radiologists. Additional results suggest that these preferences are driven by respondent favor for the readability of and confidence conveyed by the proposed reports compared to the standard report.

Conclusions: Oncologic clinicians responding to our survey preferred communication of lesion measurements in a separate report section to the current practice of embedding measurements throughout the "Findings" section, based on their assessments of reports containing simulated measurement sections assembled from a single sample report using standardized formatting.

Key Words: Structured reporting; quantitative imaging; Annotation and Image Markup; AIM; RECIST.

Imaging-derived tumor measurements serve as critical quantitative biomarkers that are used to apply disease response criteria in routine oncologic care and in pharmaceutical trials (1–4) and are as—if not more—crucial in guiding patient care in these settings as the qualitative interpretative information that radiologists generally focus on providing when creating reports. Given these clinical expectations, historical reluctance by radiologists to measure tumors and other imaging findings in addition to qualitatively describing and interpreting these findings (5,6) has given way to the now routine practice of providing quantitative data during imaging interpretation, at least in major US cancer centers (7). Not coincidentally, many oncologists in the same centers have come to expect that tumor measurements be made routinely for all patients with cancer regardless of whether a given patient is enrolled in a pharmaceutical trial (8).

Mirroring these reported trends, radiologists at our institution routinely report measured lesions—regardless of a patient's trial status—in the narrative "Findings" section of the report in prose that combines a qualitative assessment of the lesion with a quantitative assessment, the latter of which consists of the lesion's size in all relevant dimensions on the current examination, its image and series coordinates, and its size in all relevant dimensions on the prior examination, for example, "left submandibular lymph node has enlarged, measuring 14 × 9 mm on series 7, image 33 (7 × 4 mm on

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prior study dated January 1, 2001)." In this sentence, it is the qualitative assessment ("has enlarged") that represents the primary value contributed by the radiologist to the report; all other information is merely translated by the radiologist from the picture archiving and communication system (PACS) display into the report through dictation–transcription and/or typing. Unfortunately, this translated and noninterpreted information constitutes a substantial source of both errors and inefficiency in the reporting process, as these steps are executed by human agents (9,10). The demand for quantitative imaging data by ordering physicians as previously discussed only compounds the problems of introduced error and reduced interpretation efficiency associated with its generation. Furthermore, such text-based measurement reporting limits automated measurement summation or computation of disease response metrics and requires the ordering physician to tabulate this data and make any necessary calculations manually (11), further adding to the inefficiency inherent to current quantitative imaging workflow.

At our institution, we are involved in ongoing efforts to evaluate and refine a prototype PACS plug-in application that provides automated organization, archival, and communication of measurement data created by the radiologist during interpretation. This tool functions similarly to a recently reported Web-based lesion-tracking application in that it stores measurement data in extensible markup language (XML) data structures that can be mapped onto Annotation and Image Markup (AIM) (11,12). Although the relative benefits of this tool for the radiologist during image interpretation are the subject of ongoing investigation (13), an important potential benefit of this tool for ordering physicians is that it allows automated structured reporting of lesion measurements and other related image data (eg, previous study measurements and image-series coordinates) in a dedicated report section organized by lesion that can be easily inserted into a text report through copy–paste functionality by the interpreting radiologist using the tool. Although such a change in report structure could allow readers interested in measurement data to more easily access and use reported measurement data, the readability of the report could also be impacted given the separation of qualitative descriptions of measured lesions from their corresponding measurements. As such, before adoption of such a tool, it is important to better understand whether these report changes are even favored by the "consumers" of measurement-containing reports.

In this study, we tested the hypothesis that report consumers at our institution interested in quantitative imaging data would prefer the sequestration of measurements in a dedicated section to the current practice of embedding measurements throughout the narrative portion of the report, as organization of reported measurement data in this way would greatly facilitate these consumers' use of this data in assessing disease response and in guiding treatment decisions. In addition, previous clinician surveys on the subject of report structure have shown that consumers prefer reports with a more granular structure, be they reports with section headers, tables, or other itemized content (14–17). To test this hypothesis, we surveyed medical oncologists, nonphysician oncologic personnel, and radiologists at our institution to assess their preferences for sample modified reports.

To better understand how to maximize the added value of structured measurement reporting, we also assessed their preferences for the format of a dedicated "Measurements" section and the degree to which they favor modified reports over a standard report with respect to report readability and the confidence in measurements conveyed by these reports. This study builds on the aforementioned studies of consumers' report preferences by examining preferences specifically for the structure and format of reported lesion measurements and preferences of important nonphysician report consumers (described in more detail in the following). To our knowledge, no study examining either of these domains has been reported in the literature.

MATERIALS AND METHODS

This study was conducted under IRB 11-0193-E, and was exempted from institutional review board (IRB) review.

Report Preparation

An anonymized chest/abdomen/pelvis CT report with five measured lesions was selected for modification, which from here forth will be referred to as the *standard* report. This report had been dictated using a standard template used at our institution that organizes findings by organ system (Fig 1). A senior radiology resident marked the measurements in this report for the purpose of reorganizing them into a format simulating a structured "Measurements" section exportable by the lesion-tracking plug-in previously discussed. Next, a clinical informaticist manually prepared three uniquely formatted "Measurements" sections in Microsoft Word for use in three new report variants. The measurements were then removed from the narrative "Findings" section of the report and replaced by references to distinct lesion identifiers ("L1", "L2", and so forth) in the "Measurements" section. Using this edited report, three new reports were created by inserting one of three uniquely formatted "Measurements" sections in the position indicated in Figure 2. The resulting reports were called *proposed* reports. A different senior radiology resident verified readability of the proposed reports and checked that no information was added to or omitted from the standard report.

The three measurement sections are displayed in Figures 3–5, with the formatting styles used for these sections as follows:

1. "Verbose" (Fig 3)—lesion measurement information presented as a line of text modeled after the prose used currently to report measurements.
2. "Succinct" (Fig 4)—lesion measurement information presented as an ASCII-based table.