Structured Reporting in Ultrasound

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Abstract: Structured reporting of ultrasound examinations can add value throughout the imaging chain. Reports may be created in a more efficient manner, with increased accuracy and clarity. Communication with referring providers and patients may be improved. Patient care can be enhanced through improved adherence with guidelines and local best practices. Radiology departments may benefit from improved billing and quality reporting. Consistent discrete data can enable research and collaborations between institutions. This article will review the multifaceted impact of structuring ultrasound reports.

Key Words: structured reporting, templates, informatics

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Structured reports (SR) can generally be categorized into three levels of increasing standardization[1,2] (Figs. 1–3). The most basic form uses headers to divide the report into sections related to technique, clinical history, findings, and the radiologist's impression or conclusion. The second level uses subheadings to divide the findings section by the anatomic areas examined and may include prepopulated descriptions for each area. Finally, the third level of standardization includes the use of structured language throughout the report. Each of these levels has potential value in ultrasound. For example, the basic level can prompt for proper clinical information to improve abdominal aortic aneurysm screening examination reimbursement, the second level may improve information transfer to referring providers through consistent ordering and organization of findings, and the third level can ensure adherence to specific descriptors and recommendations in systems like thyroid imaging reporting and data system (TI-RADS). This review analyzes the impact of ultrasound SR on radiologists, referring providers, patients, researchers, and administrators.

EFFICIENCY AND ACCURACY

Structured reporting can increase the efficiency of producing an ultrasound report. An appropriate shell report or template can be automatically loaded upon opening the dictation software, based on the examination code of the study to be interpreted. The shell describes the technique typically used for the study and contains subheadings for the anatomic areas examined with short descriptions of normal findings. The radiologist will only need to edit the descriptors for abnormal anatomy, fill in measurements, and dictate an impression. Time required to create a report can decrease with SR, as seen with ultrasound of thyroids containing nodules, where SR averaged 6.08 minutes per dictation as compared to 8.71 minutes for free text reports ($P < 0.01$).[3]

By including standard language, which does not require dictation, a SR reduces the possibility of voice recognition and transcription errors, increases the accuracy of reports by decreasing the need for correction and addendums, and increases efficiency. Reports created with voice recognition software have a 5% to 36% error rate, with error rates for individual radiologists being as high as 92%.[4–7] Of these errors, over half affect the understanding of the report, some creating nonsense statements.[6,7] In 1 study, SR reduced nongrammatical errors from 33% to 26%, including reducing missense errors that changed the meaning of a phrase or sentence from 3.5% to 1.2%.[8] Errors can be further reduced by using software which imports measurements obtained on ultrasound machines directly into templates.[9] This not only decreases errors in the value of the measurements but can also prevent misapplication of units, such as millimeters for centimeters. Although this software is beneficial, radiologists must remain vigilant, verifying sonographers' measurements and proper transfer of data. For example, if a structure is remeasured by a radiologist or an image with an erroneous measurement is deleted before radiologist review, the original measurement may still be imported into a template and will need to be corrected before final signature.

Efficiency gains may be the greatest for normal, routine examinations. Both referring clinicians and radiologists would reject a short report only saying no abnormal findings at an examination level and would prefer a longer description of normal findings.[10,11] Indeed, referring providers and radiologists feel that an organ was not examined carefully enough, and a particular finding may not have been excluded if not mentioned explicitly.[10–12] A report prepopulated with normal descriptors allows for the preferred longer report without the radiologist needing to repeatedly dictate and correct normal findings.

COMMUNICATION

Structured reports also improve communication with referring providers through the use of clear standard language and presentation of necessary relevant data in a consistent order. Consistent language is important, as even words such as “normal” and “unremarkable” are perceived differently by radiologists and nonradiologists[13,14] and reports often contain confusing words and phrases.[15,16] Structured reports can emphasize simple style

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Examination: Renal ultrasound.

Clinical Information: [Clinical information].

Comparison: [Comparison].

Findings:
[Findings]

Impression:
[Impression]

FIGURE 1. Level 1, basic SR for renal ultrasound. Reports of this type use standardized headers to divide the report into sections, with free dictation under each header.

and vocabulary to improve understanding[10] and use of specific terms to increase clarity as compared with vague and verbose reports.[17] Indeed, referring providers find SR clearer than free-style ones[18] and 51% of the institutions who developed SR did so to standardize variable reporting styles.[19]

Structured reports can facilitate use of standard naming conventions for improved clarity. For example, an SR for a duplex ultrasound of the lower extremity veins can suggest currently accepted naming conventions rather than variable and occasionally incorrectly applied names[20] and thus avoid the term "superficial femoral vein" which may not be recognized as a deep vein needing anticoagulation if thrombosed.[21] One study found that if a standard lexicon was developed, 67% of radiologists and referring providers would prefer using it over free dictation.[10] Clarity of descriptors is especially important for adnexal lesions, where precise descriptors differentiate between benign and potentially malignant entities—"complex" is not sufficient.[22,23]

By prompting for discrete data elements, SR may supply information often lacking in traditional ultrasound reports. For example, reports for infertility examinations can remind radiologists to mention mean follicular diameter and endometrial thickness which are needed for proper timing of medications and oocyte recovery procedures.[24] This may also help with ultrasound examinations for the evaluation of fibroids, where data needed to guide treatment is missing in up to 90% of reports[25] and those with ovarian masses, where 12% of examinations need to be repeated due to incomplete reports.[26] At our institution, a thyroid ultrasound SR facilitates usage of standard TI-RADS

Examination: Renal ultrasound.

Clinical Information: [Clinical information].

Comparison: [Comparison].

Findings:

KIDNEYS
[Kidney description]

Right kidney sagittal dimension: [Right-Kidney-Length] cm.
Left kidney sagittal dimension: [Left-Kidney-Length] cm.

URINARY BLADDER
[Bladder description]

Impression:
[Impression]

FIGURE 2. Level 2, moderately SR for renal ultrasound. Reports of this type use subheadings to divide the findings section by the anatomic areas examined and may include prepopulated descriptions for each area.

Examination: Thyroid ultrasound.

Clinical Information: [Clinical information]

Technique: Multiple grayscale and color Doppler images of the thyroid and neck lymph nodes were obtained.

Comparison: [Comparison]

Findings:

Right Thyroid Lobe:
Size: [Right-Thyroid-Length] x [Right-Thyroid-Width] x [Right-Thyroid-Height] cm.
Echotexture: [Echotexture: Homogeneous/Heterogeneous]

Right Thyroid Nodule(s):

Nodule #1:
Size: [sag max] x [trans max] x [AP max] cm
Location: [right, left, isthmus: right/left/isthmus] [upper, mid, lower: upper/mid/lower]
Composition: [Composition: cystic/almost completely cystic (0)/spongiform (0)/mixed cystic and solid (1)/solid/almost completely solid (2)/cannot determine (2)]
Echogenicity: [Echogenicity: anechoic (0)/hyperechoic (1)/isoechoic (1)/hypoechoic (2)/very hypoechoic (3)/cannot determine (1)]
Shape: [Shape: not taller-than-wide (0)/taller-than-wide (3)]
Margins: [Margins: smooth (0)/ill-defined (0)/lobulated/irregular (2)/extra-thyroidal extension (3)/cannot determine (0)]
Echogenic foci: [Echogenic foci: Dictate all that apply, including point values: None (0), Large comet tail artifact (0), macrocalcs (1), peripheral calcs (2), punctate echogenic foci (3)]

ACR TI-RADS total points: [Total points]
ACR TI-RADS risk category: [Risk category:TR1/TR2/TR3/TR4/TR5]

FIGURE 3. Level 3, portion of a SR for thyroid ultrasound. Reports of this type used standardized language throughout the report, with phrases selected from a drop-down list rather than free dictation.

descriptors along with their associated point values, as requested by endocrinologists for greater clarity of nodule classification. Such structure may reduce the proportion of reports lacking complete information, which can range from 32% to 91%.[27] Structured reports may prevent the common downfall of satisfaction of search by prompting the radiologist to look at all structures on the examination, including those outside of the main focus of the study.[28,29] Indeed, referring providers find SR more complete and effective than free dictations.[30] Ultrasound examinations are typically performed as a protocol such that the same structures are always evaluated. Therefore, itemized reports with normal descriptors of these structures can provide the detail referring the providers' want without requiring radiologists to repeatedly dictate the normal descriptors for each report and while removing the possibility of dictation errors.

The consumers of ultrasound reports should also be considered, largely referring providers and patients. Referring providers prefer reports with any structure, be it headings with descriptions or tables over standard free text reports,[11,31] finding them superior for content, clarity, readability, and the ability to extract needed information.[18,32,33] For example, 85% of referring providers would like to see reports with headings for each organ system,[10] 94% of providers prefer SR over free text for adnexal masses,[34] and 80% of endocrinologists prefer SR for thyroid ultrasound.[3] Radiologists often agree, though to a lesser extent than referring providers, with both types of providers preferring SR over free text.[10,12,35] Using templates to reduce errors is especially important for patients who are increasingly the consumers of reports, accessing 80% of ultrasound reports via patient portals[36] and with 79% preferring to receive their radiology results via portal.[37] Given that patients may not understand

errors typically found in dictation and transcriptions, they may question the accuracy of reports with these errors and lose confidence in the interpreting radiologist.[38]

PATIENT CARE

One of the greatest arguments for SR is the impact on patient care. This can be by prompting radiologists to consistently use guidelines and their associated evidence-based follow-up recommendations which are otherwise not consistently applied due to lack of knowledge, incomplete recall of details, or lack of time to search for references.[39] Standard templates can also improve dissemination of updates to guidelines, as seen with ovarian mass reporting when an additional category was added to a system in active use.[34] Given that multiple reporting and grading systems have been developed for a single pathologic process, for example GI-RADS,[40] Society of Radiologists in Ultrasound,[41] O-RADS,[42] and local systems[34] for ovarian mass characterization, SR can drive adoption of a single system, chosen in conjunction with referring providers, across a health care enterprise. Indeed, 25% of institutions have developed SR to facilitate usage of these systems,[19] with 1 group finding that templates increased the proportion of reports with all required TI-RADS descriptors from less than 10% to 96%.[43] When American College of Radiology recommendations were added to the template, adherence to American College of Radiology biopsy recommendations increased from 87% to 94% ($P < 0.0067$). Our institution developed a template to standardized TI-RADS, whereas previously, radiologists used TI-RADS, Society of Radiologists in Ultrasound, or American Thyroid Association guidelines for thyroid ultrasound.

Patient benefits of SR go beyond guidelines. They can prevent unintended consequences of dictation and transcription errors, such as unnecessary surgery from an omitted "no."[44] By encouraging a full description of complex adnexal masses, inappropriate surgery can also be avoided.[45] When SR result in appropriate application of guidelines, not only are unnecessary biopsies decreased, but waiting times for necessary ones is decreased, benefitting all patients.[46] In pediatrics, templates increase the accuracy of appendiceal ultrasound, decrease equivocal reports, and decrease postultrasound computed tomography by prompting for inclusion of secondary signs.[47,48] A list of these prompts using standard nomenclature can serve as a checklist for sonographers, improving appendix visualization and diagnostic accuracy of the examination.[49] Improved accuracy leads to decreased imaging costs and reduced radiation exposure.[50] Finally, through the use of standard language or pick lists, SR can trigger alerts in the electronic medical record, including prompts for anticoagulation in patients recently diagnosed with deep vein thrombosis.[51]

BILLING AND COMPLIANCE

The economic impact of SR is not only due to increased efficiency, as detailed above, but also due to improved billing and compliance with regulations. When templates containing technical details are automatically selected based on examination code, errors in technique documentation decreased at 1 institution from 4% to 1%,[52] and flags for incorrect technique were reduced from 52/month to 9/month at another institution.[53] This can be helpful for interventions, where the modality used must be documented to bill for imaging guidance, and with obstetrics ultrasound, where the radiologist must describe all specified items or a reason why an item could not be evaluated to avoid downgrading to a limited examination with a 33% reduction in RVUs.[54] This is also a challenge for abdominal ultrasound, where incomplete documentation can be found in 9% to 20% of cases and leads to a 2.5% to 5.5% loss of revenue.[55] After implementing SR, 1 institution dropped the rate of incomplete abdominal ultrasound documentation from 15% to 3%.[56] This also improves documentation for interventions, where SR decreased the need for ultrasound guided vascular access report addenda from 32% to 3%.[57] Billing considerations prompted 36% of institutions to develop SR.[19]

Reimbursement models and value-based metrics rely on report content to determine how radiologists are paid and how those payments are adjusted. For example, the Centers for Medicare and Medicaid Services Physician Quality Reporting System measure 195 mandates that carotid ultrasound reports contain direct or indirect reference to the percentage of stenosis and suggest that the methodology used is referenced.[58] A report template can provide a pick list or prompt to capture the degree of stenosis and include a reference for the method used, including a citation. Standard language within the report can facilitate real time monitoring of such quality measures.[59] Ultrasound for screening for abdominal aortic aneurysm is only reimbursed by Medicare for certain indications[60]; if clinicians indicate an appropriate indication when ordering the examination, this can be automatically populated in the radiologist's report to facilitate payment. Finally, templates may help interventionalists include all elements required by the Joint Commission in their reports.[61]

RESEARCH AND STANDARDS

By including structured components, either shared common data elements[62] or standard language, SR can facilitate research[17] and comparison between institutions. For procedures, interventional radiology is using SR to aggregate data across practices, build national benchmarks, develop best practices, and demonstrate the value of the specialty.[61,63] For diagnostic ultrasound, SR allow comparisons in the rates of deep vein thrombosis on lower-extremity Doppler examinations across care settings to better understand risk factors and reduce inappropriate utilization.[51] Additionally, as in the case of secondary signs for appendicitis, they can facilitate the gathering of data to determine the usefulness of specific findings and refine the diagnostic process.[64]

USAGE AND ACCEPTANCE

Structured reports have been recommended for over a decade,[65] and they have found increasing usage and acceptance across radiology. In 2001, 84% of radiologists surveyed said they would use an itemized report within a voice recognition system if one could be developed.[12] Now, over half of institutions use them for at least half of their reports, with only 11% never using them.[19] Structured reports are preferred over free dictation in certain settings, including thyroid ultrasound where 76% of radiologists prefer them[3] and among interventional radiologists who find SR more complete and detailed, quicker to complete, requiring fewer edits, and as good or better for

planning subsequent procedures.[57] Sixty percent of radiologists are satisfied or very satisfied with the SR at their institution.[19]

When implementing SR, radiologist concerns should be considered and addressed. A major concern is decreased image dwell time, with radiologists looking at their dictation software rather than images for the examination they are interpreting.[1,17] This can be mitigated by using a talking template where the computer speaks the headings[32] or even a listening template, where the radiologist freely dictates and the computer edits and structures the report.[1] Some radiologists resist templates due to rigidity and loss of individual expression, with 37% thinking their reports are better than their colleagues.[10,17,66] Given that radiologists have been able to reach consensus on imaging protocols, we should be able to reach agreement on SR.[17] Institutions could leverage prior work done by the Radiological Society of North America, where radreport.org provides 252 curated templates which have been downloaded or viewed over 6 million times.[67] To make SR even more accessible, our institution's ultrasound structured templates are available as supplemental digital content for this article (see Supplemental Digital Content 1, http://links.lww.com/RUQ/A185 an XML file which can be uploaded into PowerScribe directly, and Supplemental Digital Content 2, http://links.lww.com/RUQ/A186 a document file). Indeed, radiologists want more direction on SR from radiologic societies and would be more likely to use them if someone else provided them.[17,19]

Some authors suggest starting structured reporting initiatives with disease specific templates, targeting commonly ordered studies with specific findings that can alter management.[68] One practice developed a standard template for adnexal masses, piloted it for 3 months, then achieved full scale implementation. The template was well received, with improved satisfaction and maintained 94% adherence 1 year after deployment.[34] Another institution found over 97% compliance with a deep vein thrombosis SR into their second year of use.[51] Even radiologists who question widespread SR deployment say they may have use for narrowly focused areas.[69] Others have taken a wider approach, implementing SR across the radiology department through a multistep approach including consensus building and iterative template refinement, achieving a 94% compliance within 2 years.[70]

CONCLUSIONS

Structured reports offer many benefits to the ultrasound radiologist, referring provider, patient, and practice through faster creation of more complete reports with fewer errors, enhanced communication, more appropriate patient care, greater remuneration and compliance, and facilitation of both research and standards development. Although some concerns remain to be addressed, SR are largely well accepted and widely used. Radiologists across many institutions have implemented and benefited from this style of reporting which will likely continue to disseminate throughout our practices.

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