Creation and implementation of a standardized work for CT-guided biopsy procedures
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Overview
This work was a team effort and represents the collaborative efforts of a core group of medical physicists, interventional radiologists, and technologists to improve the practice of computed tomography (CT)-guided biopsy procedures in the Interventional radiology department at The University of Texas MD Anderson Cancer Center.

At our institution, CT-guided biopsies were performed without standardization. Technical factors such as kVp and mAs for diagnostic CT exams are currently tailored to individual patients based on their size; however, in many institutions this approach is not applied for CT-guided interventional procedures. Adapting techniques to individual patients and standardizing the procedure is expected to reduce overall radiation dose and reduce variability in image quality.

These efforts are also closely aligned with the Joint Commission Sentinel Event Alert 47 [1] published in August 2011, which highlights the importance of this project. This alert addressed the need for imaging, and amongst other suggestions, recommended using the “right dose”, “Effective processes”, and establishing a “Safety culture” to protect patients undergoing imaging procedures.

Aim statement
Our goal was to standardize the performance of CT-guided biopsy procedures in interventional radiology by creating and implementing a 10-step standardized work.

Measures of success
We measured the impact of the standardized work on overall dose and image quality, while at the same time measuring the impact on factors we did not wish to affect, including procedure time, complication rate, and rate of diagnostic yield. CT metrics including the volume computed tomography dose index (CTDIvol) and dose-length product (DLP) were used to quantify dose. Image quality was assessed by measuring the coefficient of variation (CoV) in image noise between the pre-study and study periods.

We used Fisher’s exact test to evaluate categorial data, and tested differences in means in the pre-study and study periods using two-tailed *-tests. Differences in variation were measured using a size-based color-coded format, Am J Roentgenol 178:721-26, 2002.

Use of quality tools
We created a standardized work document and outlined the best practice for performing CT-guided biopsy procedures. Based on our experience, we knew that the procedural planning scan (PPS) length should be restricted to the area of interest based on prior cross-sectional imaging. We also noted that our current practice CT technique was either not adapted to patient size, or adjusted randomly. This was in contrast to best practice for diagnostic CT at our institution and other institutions [2]. Based on this knowledge, we created our standardized work (Fig. 1, lower right corner).

Interventions
Our improvement plan was implemented as follows:
1. A standardized work for performing CT-guided biopsy procedures was created. Medical physicists, interventional radiologists, and technologists collaborated to create the standardized work.
2. The standardized work was introduced to technologists and interventional radiologists. Technologists were trained in the use of the standardized work by AT (interventional radiologist) and KH (technologist supervisor).
3. The impact of the standardized work was evaluated after a three month study period by AT and KH (medical physicist).
4. Adjustments to our practice and the standardized work were made based on our findings to further drive improvement.

Results
A total of 115 biopsy procedures were analyzed between the pre-study and study periods. Overall, the total DLP decreased by 71.1 %, and CTDIvol decreased by 49.2% (mGy-cm). Pre-study DLP = 78 mGy-cm, and post-study = 14.5 mGy-cm.

Table 1. Comparison of image quality before and after implementation of standardized work.

<table>
<thead>
<tr>
<th>BMI category</th>
<th>Pre-Study</th>
<th>Study</th>
<th>Reduced (%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid organ*</td>
<td>78</td>
<td>735.7</td>
<td>58.7</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Solid lymph node</td>
<td>192</td>
<td>659.2</td>
<td>60.5</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Lung</td>
<td>265</td>
<td>11.9</td>
<td>0.365</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>All</td>
<td>612</td>
<td>13.3</td>
<td>0.400</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>

*Note: For table entries in the solid organ biopsy category include liver, kidney, adrenal, and spleen biopsies.
†BMI categories were adapted from the modified WHO criteria for classification of obesity. (http://apps.who.int/bmi/index.jsp?introPage=intro_3.html, accessed 10/31/2012)

Generalizability
Our standardized work is widely generalizable and we have already entertained requests for assistance in implementing our standardized work at other institutions in the Texas Medical Center. Technique charts can be customized for any make and model CT scanner used to perform CT-guided biopsies, and for any baseline image quality desired by the user.

Conclusion and next steps
The creation and implementation of a standardized work for performing CT-guided biopsy procedures resulted in a significant decrease in overall patient radiation dose, reduced procedural variability, and standardized image quality. We continue to improve our standardized work by evaluating new data every three months and making necessary adjustments.

References