fewer patients with thyroid nodules per year, compared with more than 50 such patients, were less likely to schedule ultrasonography examinations for positive thyroid antibody test results (OR, 0.41 [95% CI, 0.18-0.93]).

Most surveyed physicians (428 [69.3%]) reported recently published clinical guidelines as most influential in their decisions for treating patients with thyroid nodules and thyroid cancer.

Discussion | To our knowledge, this is the first survey study to evaluate use of thyroid ultrasonography by a diverse cohort of physicians involved in the care of a population-based cohort of patients with thyroid cancer. A substantial number of physicians endorsed use of ultrasonography for reasons not supported by clinical guidelines and in conflict with the Choosing Wisely recommendations.2,5,6

Our study has limitations in that direct links between physician-reported practice patterns and unnecessary thyroid cancer diagnoses were not possible, and physicians were not asked if they personally performed thyroid ultrasonography examinations or specific details about patients’ ultrasonography requests. Despite limitations, this study highlights the need for focused physician education on clinically supported and unsupported indications for use of thyroid ultrasonography, with potential roles for future clinical practice guidelines, patient decision-making aids, and clinical decision-making support tools.

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Changes in Performance of More Than 1000 Minimally Invasive Liver Resections

Laparoscopic liver resection (LLR) is gaining in popularity. The purpose of this study is to report our performance with minimally invasive liver resections.

Methods | We report our experience with LLRs in 1062 patients at a single center from calendar years 2001 to 2017. This study received expedited approval from the University of Pittsburgh institutional review board. The approval included waivers of the Health Insurance Portability and Accountability Act and the requirement of documented consent because the study used data previously deidentified. We divided performance
into 3 periods, calendar years 2001 through 2007, 2008 through 2012, and 2013 through 2017. We evaluated 5 perioperative outcomes (operating room time, transfusions, use of pure laparoscopic approach, complications, and conversions). The operations were done by 1 of 4 senior liver surgeons (A.T., D.L.B., J.W.M., and D.A.G.) and a hepatopancreato-biliary surgical fellow. Data analysis was completed from January 2018 to March 2018 with Stata version 14 (StataCorp). The statistical significance threshold was set at P < .05.

Results | A total of 1062 patients underwent LLR, including 203 in 2001 through 2007, 426 in 2008 through 2012, and 433 in 2013 through 2017. There were 664 female patients (62.5%) and 398 male patients (37.5%), with a mean age of 58 years (range, 17-94 years), a mean body mass index of 29 (range, 16-61; calculated as weight in kilograms divided by height in meters squared), and an American Society of Anesthesiologists mean (SD) score of 2.6 (0.6). The approach was purely laparoscopic in 724 patients (68.2%), hand-assisted in 134 patients (12.6%), and robotic in 74 patients (7.0%). Laparoscopic major hepatectomy (right or left lobectomy) was done in 91 of 1062 cases (8.5%), and this did not change across study periods. The indication for resection was a malignant process in 91 of 1062 cases (8.5%), and this did not change across periods. Seventy-seven patients (7.2%) developed complications (cardiopulmonary complication, 5; thromboembolism, 6; and ileus, 8). The unplanned open conversion rate was 2.5% and did not change across periods. The median hospital length of stay was 2 (range, 1-3) days. Thirty-day and 90-day mortality rates were 2 of 1062 patients (0.2%) and 4 of 1062 patients (0.4%), respectively.

Discussion | Surgical performance for LLR improved and perioperative morbidity decreased with greater experience. To our knowledge, this is one of the largest single-center series of LLR reported worldwide. Looking at LLR in more than 9500 patients, a meta-analysis showed comparable mortality and significantly fewer complications, transfusions, blood loss, and hospital stays in LLR vs open liver resection.

The common learning curve parameters are operating room time, conversions, blood loss, and morbidity. Most laparoscopic learning curve studies report on 1 of these parameters but not others. Performance and learning curves can vary with the degree of difficulty. The learning curve is a moving target and is different in the self-taught era vs the master-apprentice era.

In assessing the learning curve for laparoscopic minor hepatectomy, Vigano et al reported that conversion rate, operating room time, blood loss, use of the Pringle maneuver, and morbidity improved over 3 periods. When examining laparoscopic major hepatectomy in 173 patients, Nomi et al identified 3 phases (at 45, 30, and 98 cases) in the learning curve, using cumulative sum chart (CUSUM) analysis for operating time. Operating room time, pedicle clamping, blood loss, and conversions all improved in phase 3 vs phase 1. In 159 cases, van der Poel et al reported a conversion rate of 11% and a learning curve of 55 cases for laparoscopic hemihepatectomies. When looking at performance in 150 consecutive LLRs, Villani et al reported 5 groups of 30 consecutive cases per group. Operative complexity for laparoscopic major hepatectomy increased from 3% to 23% (in group 1 vs group 5). Complications decreased from 20% to 3% (in group 1 vs 2) but increased as more complex procedures were performed (in group 2 vs 5).

Based on our data and analysis of other published experiences, the evolution of LLR learning can be divided into 3 phases defined by 45 and 70 cases (Figure). The learning curve parameters may have periods of improvement and regression as more difficult cases are done until mastery is achieved. The goal is for training programs to shorten the learning curve.

### Table. Perioperative Parameters by Study Period

<table>
<thead>
<tr>
<th>Clinical parameter</th>
<th>Period 1, 2001-2007 (n = 203)</th>
<th>Period 2, 2008-2012 (n = 426)</th>
<th>Period 3, 2013-2017 (n = 433)</th>
<th>P value&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating room time, mean (SD), min</td>
<td>213 (95)</td>
<td>195 (87)</td>
<td>139 (62)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Transfusions</td>
<td>10 (4.9)</td>
<td>20 (4.7)</td>
<td>4 (0.9)</td>
<td>.001</td>
</tr>
<tr>
<td>Purely laparoscopic operations</td>
<td>91 (44.8)</td>
<td>290 (68.1)</td>
<td>302 (69.7)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Complications</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conversion to open technique</td>
<td>31 (15.2)</td>
<td>23 (5.4)</td>
<td>23 (5.3)</td>
<td>.82</td>
</tr>
<tr>
<td>Background cirrhosis</td>
<td>5 (2.4)</td>
<td>10 (2.3)</td>
<td>12 (2.7)</td>
<td>.002</td>
</tr>
<tr>
<td>Laparoscopic cases among all liver resections, No./total No. (%)</td>
<td>203/727 (27.9)</td>
<td>426/1263 (33.7)</td>
<td>433/1371 (31.6)</td>
<td>.01</td>
</tr>
</tbody>
</table>

<sup>a</sup> Period 1 vs period 2 or 3.
The initial phase often includes minor cases, left lateral sectionectomy (LLS), and the left lobe. The intermediate phase is associated with major, difficult segments and the right lobe. The standardization (mastery) phase is characterized by augmented liver reality and 3-dimensional, 4K, or 8K techniques. CUSUM indicates cumulative sum chart; OT, operating times; R/L, right or left lobe.

and improve performance compared with surgeons who are self-taught.

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PACIFIC COAST SURGICAL ASSOCIATION

Association of Weekend Effect With Recovery After Surgery

Weekend effect is a phenomenon that describes worse patient outcomes for patients treated on the weekend compared with the weekday. Weekend effect has been described in surgical populations and is associated with worse outcomes; however, it is unclear exactly why weekends lead to worse care. One hypothesis could be that worse processes on the weekend contribute to weekend effect, and enhanced recovery protocols are the perfect model to study this. The success of enhanced recovery protocols is particularly dependent on high adherence to process measures. Whether process measure adherence is affected by weekend effect remains unknown. Our objectives were to determine if there is an association between day of the week and process measure adherence and to identify hospital-level factors associated with weekend adherence.

Methods | Patients undergoing elective colorectal surgery at 362 hospitals in the US between January 1, 2014, and December 31, 2017, were identified using the American College of Surgeons Enhanced Recovery in National Surgical Quality Improvement Program. This study analyzed deidentified, preexisting data and was exempt from review by the Chesapeake Institutional Review Board. Adherence to 9 postoperative process measures was compared between patients undergoing surgery on Monday through Wednesday compared with Friday while risk-adjusting for procedure type and surgical complexity. American Hospital Association data were used for hospital-level factors that were modeled to determine association with adherence to process measures on the weekend. All process measures with statistical weekend effect were analyzed using clustered logistic regression models looking for significant interaction effect between hospital-level factors and weekday vs weekend groups. All analysis was performed in SAS version 9.4 (SAS Institute). Two-sided P values were statistically significant at .05. Analysis began August 2018 and ended February 2019.

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