Designing a Patient Surveillance Monitoring System for General Care Units

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“Although designed specifically for introduction of a new monitoring system in the general care setting where none previously existed, the described methods are largely generalizable to a wide variety of systems where patient monitoring is in place to prevent harm.”
—Surveillance Monitoring Management for General Care Units: Strategy, Design, and Implementation (p. 300)
Methods, Tools, and Strategies

Using Literature Review and Structured Hybrid Electronic/Manual Mortality Review to Identify System-Level Improvement Opportunities to Reduce Colorectal Cancer Mortality

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Of all cancers that affect both men and women, colorectal cancer (CRC) is second only to lung cancer in both incidence and mortality. In 2009–2013, incidence and mortality rates in the United States were 41.0 and 15.1, respectively, per 100,000 men and women. Much research related to CRC focuses on improving treatment efficacy, but opportunities for improving systems of care also exist. For example, one in three adults in the United States has not been screened for CRC as recommended; a national action campaign promotes CRC screening among men and women aged 50 years and older.

In 2006 Kaiser Permanente Southern California (KPSC; Pasadena) began leveraging the electronic health record (EHR) to improve screening rates for many conditions, including CRC. The CRC screening rate for the eligible population using Healthcare Effectiveness Data and Information Set (HEDIS) criteria improved from 45.3% in January 2006 to 81.9% in August 2014. However, in 2012, we also noted infrequent delays in diagnosis arising from failure to recognize iron deficiency anemia and/or rectal bleeding as possible CRC symptoms. We created an electronic “safety net” to increase the reliability of diagnostic processes and prevent advanced-stage CRC at diagnosis. Decreasing CRC mortality rates reflect improved detection. In 2014 the KPSC five-year mortality rate (25%) was 29% lower than comparable national rates (35%).

However, we believed a substantial proportion of CRC mortality could be prevented through more prompt evaluation of suspicious symptoms and improved surveillance and treatment. Consequently, quality and clinical leaders [J.E.S., M.H.K.] at the Southern California Permanente Medical Group (SCPMG; Pasadena) set a 10-year goal of reducing CRC mortality by 50%, from a three-year (2009–2011), age- and gender-adjusted average of 13.8 to 6.9 per 100,000 patients per year. To the best of our knowledge, no organization has achieved comparable reductions in CRC mortality, and little guidance exists in the literature as to how to achieve this goal. Consequently, our first step was to identify and examine system-level factors that both

Background: Despite colorectal cancer (CRC) screening and survival rates exceeding national averages in the United States, Kaiser Permanente Southern California (KPSC) aimed to identify system-level improvement opportunities to further reduce mortality from CRC.

Methods: To examine modifiable factors contributing to CRC mortality, a structured hybrid electronic/manual mortality review was used to examine 50 randomly selected cases among 524 individuals aged 25–75 years diagnosed with stage II, III, or IV CRC after July 2008 who subsequently died. Physicians conducted chart reviews using a standardized data extraction tool based on evidence-based best practices.

Results: Eighty-six percent (43) of the 50 decedents were initially diagnosed with stage III or IV CRC; two cases of appendiceal cancer were excluded. Thirty-one percent (15) of the remaining 48 cases presented with no history of screening; 15% (7) had documented iron deficiency anemia and abdominal pain or rectal bleeding; and 6% (3) had no follow-up colonoscopy after positive screening. Eleven (52%) of the 21 patients with initial stage II-III CRC received appropriate surveillance after curative surgery; 57% (12) developed metastases. Adjuvant chemotherapy was offered to 88% (14/16) of patients with stage III (node-positive) CRC; chemotherapy initiation was delayed in 6 patients. Missed opportunities for surgical oncology evaluation occurred among 61% (11/18) of patients with liver metastases at diagnosis. Failure to report clinically significant features on pathology occurred in 2 patients; they received appropriate treatment for other reasons.

Conclusions: Improvement opportunities existed at multiple stages of care, including screening, evaluation of symptoms, timeliness of care, use of adjuvant chemotherapy, and surgical oncology practices.
potentially affected mortality and could be modified.

Structured mortality reviews can effectively pinpoint evidence-based system-level quality improvement (QI) opportunities.7–9 Mortality reviews use structured data extraction tools to assess the health care records of deceased patients and identify modifiable system issues contributing to avoidable deaths.10–12 Structured mortality reviews can be used to examine deaths or adverse outcomes related to condition-specific care ("eAutopsy").13 Previous KPSC experience with mortality review processes yielded system-level improvement opportunities.11,13

We report here on an evidence-based structured mortality review conducted to identify system-level opportunities to improve CRC surveillance and treatment.

Methods

Setting

KPSC is one of seven regions of Kaiser Permanente, the nation’s largest not-for-profit integrated health care delivery system. Nearly 62,000 employees and staff and more than 6,000 physicians representing nearly every clinical specialty provide care for 4.1 million members. An integrated EHR is available at all points of care—14 medical centers and 209 medical offices—and approximately 1.6 million KPSC members are registered on kp.org, the EHR patient portal.

Mortality Review Process

The mortality review process is summarized in Sidebar 1 (right). We reviewed the literature to identify modifiable system-level factors affecting CRC mortality and then examined whether these issues arose in our delivery system by filtering electronic patient records to identify cases for review, developing a data extraction tool, manually reviewing patient charts, and analyzing the data.

Identifying Evidence-Based Best Practices. We used clinical guidelines from the National Comprehensive Cancer Network (NCCN) and the literature to identify potentially modifiable factors occurring after screening and diagnosis that were potentially associated with CRC mortality. NCCN guidelines pertained to surveillance schedules after curative surgery, pathologic review, adjuvant chemotherapy use and timeliness, and surgical treatment.14 We also assessed the prevalence and clinical impact of side effects from chemotherapy and radiation therapy, the contribution of comorbid conditions to mortality, and the use of perioperative blood transfusions.15,16

NCCN clinical guidelines and the literature review also provided evidence about factors associated with reduced mortality that were being addressed by existing or planned QI initiatives at KPSC. These included universal screening for Lynch syndrome and tracking physician adenoma detection rates during colonoscopy.14,17 Finally, the literature review provided evidence about the potential benefits of aspirin and vitamin D use and exercise.18–31

Electronic Filtering of Patient Records. We electronically filtered all KPSC patient records by variables contained in the hospital coding database to obtain a pool of charts from which to select cases for review. We identified individuals aged 25 to 75 years with stage II, III, or IV CRC diagnosed after July 2008 who subsequently died. Of 524 patients meeting these criteria, we selected every fifth case until 50 cases for review were identified.

Data Extraction Tool Development. The data extraction tool was developed by two authors [K.C.L., H.L.] who were experienced at conducting focused mortality reviews for QI, in consultation with the KPSC clinical leader for oncology [J.E.S.]. The iterative development process took place in a two-month period. In our previous structured mortality reviews, limiting the number of questions to approximately 20 kept the process from becoming burdensome for reviewers, so we aimed for the same number of questions and used response options of yes/no/other when possible. They were designed to identify areas of practice variation or failure to provide evidence- or consensus-based care that potentially impacted outcomes. We focused on care pathways occurring after diagnosis, eliminating evidence-based factors for which QI efforts were already under way and for which EHR documentation was inconsistent (for example, use of over-the-counter products and exercise).

We divided the data extraction tool into sections for review by physicians with specific clinical and QI expertise. Three reviewers validated the tool by applying it in a small sample of

Sidebar 1. Mortality Review Process

- Obtain leadership support and sponsorship for the review.
- Identify a clinical topic to be reviewed and the outcome of interest.
- Review the literature in the clinical topic to identify system-level factors potentially affecting the outcome of interest that can be modified (for example, care pathways and processes).
- Collaboratively with experts in the clinical topic, develop a data extraction tool comprising approximately 20 questions and reflecting evidence-based modifiable factors.
- Identify the population of affected patients and sample charts by random or purposeful sampling (for example, consecutively over time).
- Conduct manual chart reviews using the data extraction tool and expert clinicians in domains of the clinical topic (for example, surgery, oncology, radiology, pathology).
- Tabulate results.
- Identify quality improvement opportunities and report to leadership to address identified system improvements.
cases to ensure that questions were unambiguous and comprehensible. Some questions were added or edited in response to their input. The complete tool included 17 items with yes/no/other response options and six text fields for specific data or clarifying “other” responses (Appendix 1, available in online article). An additional item solicited a narrative case summary, in which reviewers identified opportunities to improve, delays, unique aspects, errors, and other salient factors. In our previous experience, sharing brief case narratives effectively communicated system-level issues and opportunities to senior leaders in a patient-centered and accessible manner, helping to inspire and energize QI.11

**Manual Review Process and Analysis.** Between August 2013 and February 2014, six physicians with expertise in pathology [N.S.A.], surgical oncology [L.A.D.], medical oncology and hematology [J.E.S., G.E.S, F.M.B.], and QI [K.C.L.] conducted chart reviews. Each reviewer looked at items on the data extraction tool relevant to his or her area of expertise. Manual reviews required 15–30 minutes per case for each reviewer, depending on complexity.

When manual reviews were complete, we [J.E.S., K.C.L., H.L.] aggregated and analyzed the data to identify patterns reflecting variations in care or gaps between evidence-based care and the care patients received. The study received approval from the KPSC Institutional Review Board.

**Results**

Of the 50 cases reviewed, 10% (5) of decedents were initially diagnosed with stage II CRC, 31% (16) were initially diagnosed with stage III disease, and 54% (27) were initially diagnosed with stage IV disease. Two (4%) of the 50 cases of primary appendiceal cancer were excluded from further analysis.

**Surveillance.** For the remaining 48 cases, we assessed the adequacy of surveillance after curative surgery and the development of metastases in 21 patients with stage II-III CRC at diagnosis. The proportion of cases in which patients received surveillance was 52% (11) for follow-up colonoscopy at one, three, and five years, 52% (11) for carcinoembryonic antigen (CEA) testing every six months for five years, and 57% (12) for computerized tomography (CT) scan of chest/abdomen/pelvis. Reasons why decedents did not receive surveillance included death from surgical complications or comorbid conditions, patient refusal, and discontinuation of KPSC membership. Among patients with stage II-III CRC at diagnosis, 57% (12) developed metastases.

**Medical Treatment.** We examined the use of adjuvant chemotherapy among patients for whom it was indicated and the prevalence of serious side effects. Among 16 patients with stage III (node-positive) CRC, adjuvant chemotherapy was offered to 88% (14). Ten (63%) patients completed adjuvant chemotherapy; 1 patient and 1 health care proxy declined, and 2 patients had severe side effects necessitating discontinuation. Adjuvant chemotherapy was not offered to 2 patients because of their baseline medical or functional status.

For 6 patients, adjuvant chemotherapy was initiated > 35 days after surgery; wait times beyond 35 days ranged from 1 to 11 weeks. Initiation was delayed in 3 patients because of prolonged recovery from tumor resection or poor performance status; reasons for the delay were not specified for the remaining patients. One patient with high-risk stage II CRC (< 12 lymph nodes resected) was not offered adjuvant chemotherapy for unclear reasons. Among 10 patients receiving chemotherapy, serious side effects occurred in 33% (3), resulting in dose modifications and early discontinuation.

**Timeliness of Surgical Interventions After Development of Metastatic Disease.** We assessed the timeliness of surgical intervention following the development of metastases among patients with stage II-III CRC at diagnosis. No patients who developed metastatic disease while under surveillance experienced delays in referrals to a surgical oncologist or between surgical oncology evaluation and a subsequent operative procedure.

**Pathology Finding.** The goal of the pathology review was to look for unreported histologic/pathologic clues that might have contributed to understaging. Focal areas of the review included the number of lymph nodes recovered, evidence of micrometastases in lymph nodes, lymphovascular invasion (LVI), histologic subtype of the carcinoma (signet ring and mucinous), and the status of margins, particularly radial.

Slides were available for 33 cases. No evidence was found for understaging of disease. In 9 patients, fewer than 12 lymph nodes were recovered; 6 of these patients received neoadjuvant or adjuvant chemotherapy or both. Two patients with only disease-free lymph nodes received no chemotherapy. An additional patient was too ill to undergo adjuvant chemotherapy after neoadjuvant therapy and surgical resection. LVI and focal mucinous carcinoma were not reported for 2 patients; however, both received adjuvant chemotherapy for other reasons.

**Radiation Treatment.** We evaluated the potential impact on mortality of serious side effects from radiation therapy. Of 7 patients receiving radiation therapy for CRC at any stage, serious side effects occurred in 2. However, the side effects did not contribute to mortality.

**Surgical Treatment.** We assessed referral patterns to surgical oncology for metastatic disease, evidence of disease at surgical
closure, and diagnostic adequacy of surgery. Of 18 decedents with metastatic liver disease on presentation, referral to surgical oncology to evaluate resectability was appropriate for 7 patients. Of these, 3 were referred to surgical oncology and 1 subsequently underwent resection of liver metastases with clear surgical margins. In terms of diagnostic adequacy, among 38 decedents who had surgery after diagnosis, 82% (31) had 12 lymph nodes resected. Two patients had 11 or fewer nodes removed after preoperative chemoradiation, 1 had a palliative resection, and 1 had surgery before becoming a KPSC member.

Other Treatment and Interventions. We assessed the impact of potentially preventable comorbid conditions unrelated to CRC on mortality and the use of blood transfusions. Pulmonary embolism and sepsis were assessed as causing death in 2 patients. The question on blood transfusions failed to specify the CRC perioperative period, yielding uninterpretable results.

Additional Findings. Although the mortality review did not examine screening, reviewers’ narrative summaries identified 15 cases in which patients presented with CRC and no history of screening. Seven patients had documented iron deficiency anemia and abdominal pain or rectal bleeding but had not been screened for CRC; 3 of these patients did not complete the fecal occult blood test (FOBT) or colonoscopy as recommended by providers.

Discussion
The structured mortality review identified improvement opportunities at every stage along the CRC care path in an organization with baseline screening and mortality rates better than those reported for the population of the United States.1,32 KPSC quality leaders identified five major variations in care that became the focus of continuing efforts to improve CRC detection and treatment: screening, evaluation of symptoms, timeliness of care, use of adjuvant chemotherapy, and surgical oncology practices.

Although CRC screening was not a focus of the structured mortality review and despite a high baseline screening rate, findings from the review identified it as a QI opportunity. Only 3 patients were reported as being up to date on CRC screening at diagnosis. Nearly one third of patients had no documentation of past screening. Consequently, improving screening rates continued as an organizational QI initiative. Strategies to improve screening rates included coordinated outreach to all eligible members using their preferred screening option (FOBT, sigmoidoscopy, or colonoscopy), “live” telephone calls to augment other outreach strategies, in-reach at all ambulatory and inpatient settings, a pilot of colonoscopy outreach for patients at average CRC risk, and maintaining high quality and volume models of endoscopic care. However, despite high baseline rates and increased effort, we anticipate reaching a screening rate ceiling related to nonadherence to recommendations. Among all cases reviewed, 4 were documented as not following through on screening recommendations, reflecting a nonadherence rate of 8.3%. If validated, this indicates a possible ceiling rate of approximately 91%, which KPSC continues to approach. In October 2014, four hospital service areas had screening rates greater than the regional goal of 83%, and the highest service-area screening rate was 84.4%.

Strategies to improve symptom evaluation include the development of clinical guidelines for evaluating the co-occurrence of iron deficiency anemia and rectal bleeding. KPSC has an electronic clinical surveillance program to identify and resolve potential care gaps in the outpatient setting.5,33 The program now includes a goal of increasing the use of colonoscopy among members with documented or presumed iron deficiency anemia or a history of rectal bleeding and no colonoscopy in the past 10 years. Outreach typically occurs via automatically generated letters; however, if FOBT outreach kits have not been returned within 30 days, a live call from a trained nurse is made to encourage the patient to return the kit or book a colonoscopy. These calls have increased the kit return rate by about 10%. Since KPCS has implemented outreach, patients with polyps, adenomas, and cancer have received colonoscopy and subsequent treatment as needed.

The mortality review revealed that 42% of patients who received chemotherapy did so within 35 days. Biagi et al. found that survival decreased 14% for every four-week delay between surgery and starting chemotherapy.34 To improve timeliness of care, the chiefs of surgery and oncology throughout KPSC adopted a goal of decreasing the time from surgery to chemotherapy, with the goal of 80% of patients starting chemotherapy within 35 days.35-37 The proportion of patients receiving chemotherapy within 35 days gradually improved from 39% in 2013 to 58% in the first half of 2015. The chiefs of surgery and oncology, as well as the KPSC CRC mortality group, track to ensure that evidence-based surveillance follows treatment.

Offering adjuvant chemotherapy at KPSC to 88% of patients with node-positive CRC compared favorably with national use rates of 65% among patients with node-positive (N1-2) disease.38 To continue to improve delivery of adjuvant chemotherapy, KPSC instituted a care pathway in which all stage II patients receive an oncology consultation, which will capture those with fewer than 12 lymph nodes resected. In 2015, 93% of stage II patients received referrals to medical oncology. To improve surgical oncology practices, a metric was implemented

July 2016 Volume 42 Number 7

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to track the number of patients with metastatic disease on diagnosis who are evaluated by surgical oncology. As of the fourth quarter of 2015 (October–December), 95% of these patients were seen by surgical oncology. In addition, KPSC developed a multidisciplinary regionwide tumor board, which helps facilitate referrals and discussion of treatment recommendations.

As noted above, the review of literature revealed other factors related to CRC prevention and detection that were not included in the structured mortality review. However, additional major opportunities for improvement in CRC mortality exist, and strategies to address them are under way.

To begin addressing genetic components of CRC, in 2014 the clinical laboratory started universal testing of polyp specimens for Lynch syndrome, for which the lifetime risk of developing CRC has been reported as 8%–53%. Evidence from a limited number of observational studies suggests that vitamin D intake and serum 25-hydroxyvitamin D levels are inversely associated with risk of CRC.28–30,42 Adenoma detection rates (ADRs) of physicians performing colonoscopy are inversely associated with the risks of developing CRC 6 months to 10 years after the procedure and have been suggested as a quality indicator.17,61 Reducing variations in ADRs across KPSC physicians performing colonoscopies is a key QI goal, and KPSC has developed the capacity to generate physician-level ADR reports.

The literature review also identified evidence related to lifestyle and over-the-counter medications and dietary supplements. Increased physical activity after diagnosis with CRC is associated with risk reductions of 45%–61% for CRC mortality and 23%–63% for all-cause mortality.18–20 KPSC providers routinely assess physical activity while rooming patients for ambulatory care encounters. A first step toward helping patients lower the risk of CRC mortality is to evaluate the frequency with which all patients reporting < 150 minutes per week of physical activity are counseled to increase their activity or referred to health coaching.

Evidence from a limited number of observational studies assessing the role of aspirin in reducing CRC mortality is less robust but highly suggestive.21–26 Finally, emerging evidence suggests that vitamin D intake and serum 25-hydroxyvitamin D levels are inversely associated with risk of CRC.28–30,42 KPSC providers currently recommend aspirin and vitamin D for many members to reduce cardiovascular risk and promote bone health; planned interventions include point-of-care decision support in the EHR to ensure that all appropriate patients take aspirin and vitamin D.

After the first year of implementing multiple strategies, the age- and gender-adjusted average mortality rate for CRC at KPSC decreased from 13.8 to 12.5 per 100,000 patients per year—an encouraging start to the mortality reduction program. The 2015 mortality rate was 11.85 per 100,000 patients. Ongoing assessment is required to track overall progress toward the 10-year goal of 6.9 deaths from CRC per 100,000 patients per year.

Limitations to our review process include the fact that the review question related to blood transfusions did not specify a perioperative time frame; results included transfusions patients received at many points in care, rendering this information less valuable. Despite multiple iterative reviews of the data collection tool, this shortcoming was not detected, highlighting the importance of careful tool review. In addition, we were only able to review patients whose care was provided exclusively at KPSC facilities. Finally, we excluded patients older than 75 years of age because age-related comorbidities may contraindicate chemotherapy or surgical interventions. However, patients in this age group comprise a substantial proportion of all patients with CRC. Future reviews should include this group of patients as a subset with specialized questions addressing age-related care issues.

Conclusions
A literature review and structured hybrid electronic/manual mortality review revealed substantial opportunities for improving CRC prevention, screening, treatment, and surveillance. KPSC initiatives address each opportunity. Further research is required to assess the extent to which they contribute to meeting our goal of reducing mortality from colorectal cancer by 50% over the next 10 years.

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See the online version of this article for Appendix 1. Data Extraction Tool
References


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## Appendix 1. Data Extraction Tool

<table>
<thead>
<tr>
<th>Questions</th>
<th>Response options</th>
<th>Reviewer Assignment</th>
</tr>
</thead>
</table>
| **1a** Surveillance: Performed according to standard? Colonoscopy frequency—within one year, then 3 years after that, 5 years after that (sooner intervals if advanced adenomas found). | □ Yes  
□ No  
□ Other, use item 8 for comments                                                                                     | Oncologist          |
| **1b** Surveillance: Performed according to standard? CEA (carcinoembryonic antigen) frequency—every 6 months for 5 years. | □ Yes  
□ No  
□ Other, use 8 for comments                                                                                     | Oncologist          |
| **1c** Surveillance: Performed according to standard? CT scan chest/abdomen/pelvis frequency—annually for 5 years. | □ Yes  
□ No  
□ Other, use 8 for comments                                                                                     | Oncologist          |
| **1d** Surveillance: Did patient have stage II/early stage cancer that metastasized? | □ Yes (review pathology slides to identify possible diagnostic errors, then answer 1e)  
□ No  
□ Other                                                                                                             | Pathologist         |
| **1e** Review of pathology slides: If yes to question 1d, were there discrepancies between original pathology report and reviewer’s diagnosis? | □ Yes (explain below)  
□ No  
□ Other                                                                                                             | Pathologist         |
| **2a** Timeliness of intervention: Was there a delay in following appropriate surveillance for patients who developed metastatic disease? | □ Yes, please indicate estimate of delay in days on 2d  
□ No  
□ Other, use 2d for comments                                                                                     | Oncologist          |
| **2b** Timeliness of intervention: If patient developed metastases while on surveillance, was the physician late in referring to an oncologic surgeon? | □ Yes, please indicate delay in days on question 2d  
□ No metastases while on surveillance  
□ Did develop metastases while on surveillance but no delay noted  
□ Other, use 2d for comments                                                                                     | Surgeon            |
| **2c** Timeliness of intervention: If patient developed metastases while on surveillance, were there delays by the oncologic surgeon in getting the patient to the OR? | □ Yes, delays were evident, please indicate delay in days on 2d  
□ No metastases while on surveillance  
□ Did develop metastases while on surveillance but no delay noted  
□ Other, use 2d for comments                                                                                     | Surgeon            |
| **2d** Timeliness of intervention: Please indicate delays in days from all of the above questions. | Text input                                                                                              | Surgeon            |
| **3a** Medical treatment: Was adjuvant chemotherapy offered/given for node-positive (AKA stage III) colon cancer? | □ Yes, offered and given  
□ Offered, not given use 3d for comments  
□ Not offered use 3d for comments  
□ Other, use 3d for comments                                                                                     | Oncologist          |
| **3b** Medical treatment: Was adjuvant chemotherapy offered/given for high risk stage II colon cancer (an option for poorly differentiated, lymphatic or vascular invasion, positive margins, less than 12 lymph nodes removed, perforation, T3 tumor through the muscularis)? | □ Yes, offered and given  
□ Offered, not given use 3d for comments  
□ Not offered use 3d for comments  
□ Other, use 3d for comments                                                                                     | Oncologist          |

(continued on page AP2)
### Appendix 1. Data Extraction Tool (continued)

<table>
<thead>
<tr>
<th></th>
<th>Question</th>
<th>Options</th>
<th>Responsible Party</th>
</tr>
</thead>
<tbody>
<tr>
<td>3c</td>
<td><strong>Medical treatment:</strong> Did side effects/toxicity from chemotherapy result in serious morbidity or mortality?</td>
<td>□ Yes, serious side effects noted <em>(describe in 3d)</em>&lt;br&gt;□ No serious side effects&lt;br&gt;□ N/A, no chemotherapy&lt;br&gt;□ Other, use 3d for comments</td>
<td>Oncologist</td>
</tr>
<tr>
<td>3d</td>
<td><strong>Comments regarding medical treatment</strong></td>
<td>Text input</td>
<td>Oncologist</td>
</tr>
<tr>
<td>4</td>
<td><strong>Radiation treatment:</strong> Did side effects/toxicity from radiation result in serious morbidity or mortality?</td>
<td>□ Yes, serious side effects noted, describe in 3d&lt;br&gt;□ No serious side effects&lt;br&gt;□ N/A, no radiation treatment&lt;br&gt;□ Other, use 8 for comments</td>
<td>Oncologist</td>
</tr>
<tr>
<td>5a</td>
<td><strong>Surgical treatment:</strong> Referral to oncologic surgeon for evaluation of resectability of liver metastases?</td>
<td>□ Yes, referred to oncologic surgeon&lt;br&gt;□ Not referred but should have been&lt;br&gt;□ Not referred and not indicated&lt;br&gt;□ Other, use 5d for comments</td>
<td>Surgeon</td>
</tr>
<tr>
<td>5b</td>
<td>If liver metastasis excision performed, were margins clear?</td>
<td>□ Yes, margins clear&lt;br&gt;□ No, margins were not clear&lt;br&gt;□ N/A, no excision of liver mets done.&lt;br&gt;□ Other, use 5d for comments</td>
<td>Surgeon</td>
</tr>
<tr>
<td>5c</td>
<td><strong>Adequacy of diagnostic evaluation:</strong> Were at least 12 lymph nodes removed?</td>
<td>□ Yes&lt;br&gt;□ No, describe below in 5d if indicated&lt;br&gt;□ Other, use 5d for comments</td>
<td>Surgeon</td>
</tr>
<tr>
<td>5d</td>
<td><strong>Comments for 5a,b,c</strong></td>
<td>Text input</td>
<td>Surgeon</td>
</tr>
<tr>
<td>6</td>
<td>Did the patient die of potentially preventable comorbid disease (e.g., MI, sepsis)</td>
<td>□ Yes, died of potentially preventable non-oncologic condition&lt;br&gt;□ No, did not die of potentially preventable non-oncologic condition&lt;br&gt;□ Other, use 8 for comments</td>
<td>Quality physician</td>
</tr>
<tr>
<td>7a</td>
<td><strong>Time interval between surgery and administration of adjuvant chemotherapy?</strong></td>
<td>□ Did not undergo surgery&lt;br&gt;□ Underwent surgery but did not receive adjuvant chemotherapy&lt;br&gt;□ Enter number of weeks between surgery and administration of adjuvant chemotherapy in the text box below&lt;br&gt;□ Other, use 8 for comments</td>
<td>Oncologist</td>
</tr>
<tr>
<td>7b</td>
<td>Enter number of weeks between surgery and administration of adjuvant chemotherapy.</td>
<td>Text input in weeks</td>
<td>Oncologist</td>
</tr>
<tr>
<td>7c</td>
<td><strong>Blood transfusion:</strong> Please enter number of units patient received. Please use N/A for no blood transfusion ordered and 0 for blood transfusion ordered but patient did not receive any units.</td>
<td>Text input</td>
<td>Quality physician</td>
</tr>
<tr>
<td>8</td>
<td><strong>Comments for “other” response above</strong></td>
<td>Text input</td>
<td>ALL</td>
</tr>
<tr>
<td>9</td>
<td>Please briefly summarize the patient’s story to document important aspects of his or her course, including opportunities to improve, delays in care, unique aspects of care, errors, etc.</td>
<td>Text input</td>
<td>Oncologist</td>
</tr>
</tbody>
</table>

CT, computerized tomography; OR, operating room; AKA, also known as; N/A, not applicable; MI, myocardial infarction.

The complete data extraction tool, divided into sections for review by physicians with specific clinical and quality improvement expertise, as shown, included 17 items with yes/no/other response options (1a–1e; 2a–2c; 3a–3c; 4; 5a–5c; 6; 7a) and seven text fields for specific data or clarifying “other” responses (2d, 3d, 5d, 7b, 7c, 8, 9).