

## What studies are appropriate and necessary for staging gastric adenocarcinoma? Results of an international RAND/UCLA expert panel

Matthew Dixon · Roberta Cardoso · Jill Tinmouth · Lucy Helyer · Calvin Law · Carol Swallow · Lawrence Paszat · Robin McLeod · Rajini Seevaratnam · Alyson Mahar · Natalie G. Coburn · The Gastric Cancer Processes of Care Expert Panel

Received: 10 January 2013 / Accepted: 5 April 2013 / Published online: 30 April 2013  
© The International Gastric Cancer Association and The Japanese Gastric Cancer Association 2013

### Abstract

**Background** The approach for staging gastric adenocarcinoma (GC) has not been well defined, with heterogeneity in the application of staging modalities.

**Methods** Utilizing a RAND/UCLA appropriateness methodology (RAM), a multidisciplinary expert panel of 16 physicians scored 84 GC staging scenarios. Appropriateness was scored from 1 to 9. Median appropriateness scores from 1 to 3 were considered inappropriate, 4–6 uncertain, and 7–9 appropriate. Agreement was reached when 12 or more of 16 panelists scored the scenario similarly. Appropriate scenarios were subsequently scored for necessity.

Gastrointestinal-American Society of Clinical Oncology Annual Meeting, San Francisco, CA, USA, January 2012.  
Society of Surgical Oncology Annual Cancer Symposium, Orlando, FL, USA, March 2012.

**Electronic supplementary material** The online version of this article (doi:10.1007/s10120-013-0262-x) contains supplementary material, which is available to authorized users.

M. Dixon · R. Cardoso · J. Tinmouth · C. Law · R. Seevaratnam · A. Mahar · N. G. Coburn  
Sunnybrook Research Institute, Toronto, ON, Canada

M. Dixon  
Department of Surgery, Maimonides Medical Center, Brooklyn, NY, USA

J. Tinmouth · C. Law · L. Paszat · R. McLeod · N. G. Coburn  
Department of Health Policy, Management and Evaluation, University of Toronto, Toronto, ON, Canada

J. Tinmouth · C. Law · L. Paszat · N. G. Coburn  
Institute for Clinical Evaluative Sciences, Toronto, ON, Canada

J. Tinmouth  
Division of Gastroenterology, Department of Medicine, University of Toronto, Ontario, Canada

**Results** Pretreatment TNM stage determination is necessary. Necessary staging maneuvers include esophagogastroduodenoscopy (EGD); biopsy of the tumor; documentation of tumor size, description, location, distance from gastroesophageal junction (GEJ), and any GEJ, esophageal, or duodenal involvement; if an EGD report is unclear, surgeons should repeat it to confirm tumor location. Pretreatment radiologic assessment should include computed tomography (CT)-abdomen and CT-pelvis, performed with multidetector CT scanners with 5-mm slices. Laparoscopy should be performed before resection of cT3–cT4 lesions or multivisceral resections. Laparoscopy should include inspection of the stomach, diaphragm, liver, and ovaries.

**Conclusions** Using a RAM, we describe appropriate and necessary staging tests for the pretreatment staging evaluation of GC, as well as how some of these staging maneuvers should be conducted.

L. Helyer  
Department of Surgery, Dalhousie University, Halifax, NS, Canada

C. Law · C. Swallow · R. McLeod · N. G. Coburn  
Department of Surgery, University of Toronto, Toronto, ON, Canada

A. Mahar  
Department of Community Health and Epidemiology, Queen's University, Kingston, ON, Canada

N. G. Coburn (✉)  
Suite T2-60, Division of Surgical Oncology, Odette Cancer Centre, Sunnybrook Health Sciences Centre, 2075 Bayview Ave, Toronto, ON M4N 3M5, Canada  
e-mail: natalie.coburn@sunnybrook.ca

**Keywords** Gastric cancer · Staging · Endoscopy · Radiology · Laparoscopy

## Introduction

Management of gastric adenocarcinoma (GC) is complex and resource intensive [1]. Decisions require planning by a multidisciplinary team. The foundation of treatment planning is accurate staging of tumor depth (T), regional lymph node (LN) involvement (N), and distant metastases (M) [2]. Several techniques are available for evaluation of GC, including esophagogastroduodenoscopy (EGD) and biopsy, computed tomography (CT) scan of the chest, abdomen, and pelvis, positron emission tomography (PET) scan, endoscopic ultrasound (EUS) with fine-needle aspiration (FNA), staging laparoscopy, and peritoneal cytology.

Although guidelines exist describing the workup and treatment for GC [3–6], the application of staging techniques is not uniform [7–9]. Furthermore, existing guidelines do not convey the relative importance of individual tests, nor do they comment how these tests should be performed. Standardization of staging of GC could lead to the most appropriate stage-specific treatment and improved outcomes. Therefore, we performed a RAND/UCLA appropriateness methodology (RAM) study to clarify appropriate and necessary processes of care in the pre-treatment staging of GC.

## Methods

The RAM is a well-described modified Delphi methodology [10–14], developed to determine appropriate care in situations where strong, evidence-based guidelines are not possible. Briefly, members for an expert panel were recruited. From the applicants, a multidisciplinary expert panel of 16 physicians from six countries was assembled (ESM Appendix 1). A detailed literature review [15–18] was conducted to synthesize the latest evidence regarding staging and provided to the panelists.

Matrices of clinical scenarios regarding staging were written, pilot tested, and revised to a total of 84 scenarios. These scenarios were sent to the panelists, who scored them for appropriateness, which is defined as “the expected health benefit of an intervention exceeding the expected negative consequences by a wide enough margin that the procedure is worth doing, regardless of cost” [19]. Appropriateness was scored from 1 (highly inappropriate) to 9 (highly appropriate) [13]. Panelists returned their scores and data were analyzed for areas of agreement.

The panel met in Toronto, Ontario, October 22–24, 2010, for discussion of the scenarios and scoring, focusing

on areas of disagreement. Some scenarios were rewritten for clarification. All scenarios were confidentially rescored. During final analysis, scenarios were classified as appropriate when median appropriateness scores (MAS) was 7–9, with agreement; inappropriate when MAS was 1–3, with agreement; and uncertain when MAS was 4–6, with agreement. Agreement was met when  $\leq 4$  panelists rated outside the 3-point region containing the median (i.e., 1–3, 4–6, 7–9). Disagreement occurred when  $\geq 4$  panelists rated in each extreme 3-point region (i.e., 1–3, 7–9). The level of agreement was indeterminate when it failed to satisfy either of these criteria [13].

When a scenario was agreed to be appropriate, it was subsequently scored for necessity, defined as “the expected health benefits exceeding the expected harms by such a margin that the service must be offered to the patient” [13, 20]. In the final classification each statement could be labeled as (1) necessary (i.e., appropriate, and necessary); (2) appropriate, but not necessary; (3) uncertain; (4) inappropriate; (5) indeterminate; or (6) disagreement. The study design was approved by the Research Ethics Board, Sunnybrook Health Sciences Centre.

## Results

Final levels of agreement and MAS or median necessity scores (MNS) are summarized in Tables 1, 2, and 3, and ESM Appendices 2–4. When a scenario is necessary, only the MNS is shown. For all other final levels of agreement, the MAS is shown. Major themes include (1) general staging, (2) endoscopy, (3) radiologic assessment, (4) EUS, and (5) laparoscopy.

Panelists agreed it is necessary that TNM stage be determined preoperatively (ESM Appendix 2). Panelists thought it is necessary for all patients to receive an EGD before surgery, and endoscopists should biopsy the tumor and document its (1) size, (2) appearance, (3) location, (4) distance from the gastroesophageal junction (GEJ), (5) GEJ involvement, (6) esophageal involvement, and (7) duodenal involvement. Before resection, surgeons should repeat the EGD if original EGD reports are unclear (Table 1).

Panelists agreed it is necessary to (1) obtain CT-abdomen/pelvis and (2) perform CT scans using multidetector CT scanners (MDCT) with 5-mm slices. Panelists agreed it is appropriate, but not necessary, to perform (1) CT-chest, and (2) CT scans with MDCT capable of 64 slices (Table 2). Panelists agreed it is uncertain whether PET scan should be performed for preoperative assessment (ESM Appendix 3).

The panel agreed EUS is appropriate before endoscopic resection, but not necessary. The role of EUS before surgical resection is indeterminate (ESM Appendix 4).

**Table 1** Appropriateness and necessity of practices in pretreatment upper gastrointestinal (GI) endoscopy studies in the staging of gastric adenocarcinoma

Scenario: pretreatment endoscopy	Final level of agreement
All patients should have a diagnostic upper endoscopy before surgery	<b>Necessary (9.0)</b>
The endoscopist should document tumor size	<b>Necessary (7.0)</b>
The endoscopist should describe the tumor	<b>Necessary (8.0)</b>
The endoscopist should biopsy the tumor	<b>Necessary (9.0)</b>
The endoscopist should biopsy normal tissue	Indeterminate (5.0)
The endoscopist should describe the tumor location within the stomach	<b>Necessary (9.0)</b>
The endoscopist should document the distance from the incisors to the tumor	Indeterminate (8.0)
The endoscopist should document the distance from the GE junction to the tumor	<b>Necessary (7.0)</b>
The endoscopist should document the distance from the pylorus to the tumor	Indeterminate (6.0)
The endoscopist should document GE junction involvement	<b>Necessary (8.5)</b>
The endoscopist should document esophageal involvement	<b>Necessary (9.0)</b>
The endoscopist should document duodenal involvement	<b>Necessary (8.0)</b>
The endoscopist should document retroflexion	<b>Appropriate (8.0)</b>
For GE junction tumors, the endoscopist should biopsy normal-appearing tissue proximal to the lesion to evaluate for submucosal spread in the oesophagus	Indeterminate (5.5)
For GE junction tumors, the endoscopist should define the tumor by Siewert type	<b>Appropriate (8.0)</b>
The endoscopist should tattoo all lesions	Indeterminate (4.0)
The endoscopist should tattoo lesions that are flat	Indeterminate (6.0)
The endoscopist should tattoo lesions that are <2 cm in diameter	Indeterminate (7.0)
The endoscopist should tattoo lesions that are in the proximal stomach	<b>Uncertain (5.0)</b>
The endoscopist should tattoo lesions that are in the midbody of the stomach	Indeterminate (5.0)
The endoscopist should tattoo lesions that are in the distal stomach	<b>Uncertain (5.0)</b>
The endoscopist should tattoo lesions if a laparoscopic resection may be performed	<b>Appropriate (7.0)</b>
The endoscopist should tattoo lesions if neoadjuvant chemotherapy may be given	Indeterminate (6.0)
The endoscopist should take photographs of the tumor	Indeterminate (6.0)
The endoscopist should record a video of the procedure	<b>Uncertain (5.0)</b>
The endoscopist should send biopsies for <i>Helicobacter pylori</i> analysis	<b>Appropriate (7.0)</b>
Before resection, the surgeon should perform a repeat endoscopy to confirm tumor location for all patients	<b>Uncertain (5.0)</b>
Before resection, the surgeon should perform a repeat endoscopy to confirm tumor location of proximal gastric tumors	Indeterminate (5.0)
Before resection, the surgeon should perform a repeat endoscopy to confirm tumor location if the original EGD report is unclear	<b>Necessary (8.0)</b>
During endoscopy, 6–8 biopsies of the cancer should be taken for HER-2 testing	Indeterminate (5.0)

Results shown as final level of agreement, and the median appropriateness or necessity score on a scale of 1–9. Results in bold indicate agreement was met

NA not applicable, GE gastroesophageal, EGD esophagogastroduodenoscopy

Panelists agreed laparoscopy is necessary, in patients planned for resection of suspected T3–4 lesions, and for planned multivisceral resections (Table 3). Panelists agreed it is appropriate, but not necessary, to perform laparoscopy on patients whose pretreatment imaging shows positive LNs. During laparoscopy, the panel agreed it is necessary to visually inspect the (1) stomach, (2) diaphragm, (3) liver, and (4) ovaries. Panelists agreed that sending ascites/peritoneal washings for Papanicolaou stain examination was appropriate during laparoscopy, but not necessary.

## Discussion

GC is relatively rare in Western countries, where, despite existing guidelines [3–6], there is a lack of consistency in pretreatment staging [7, 8]. Determination of appropriate and necessary practices may help create uniformity in the pretreatment staging of GC. Although the wording for the scenarios was “preoperative,” patients under consideration for a neoadjuvant chemotherapy approach should be staged before treatment initiation. Patients who are not operative candidates, or have evidence of metastatic disease on

**Table 2** Appropriateness and necessity of pretreatment radiologic studies in the staging of gastric adenocarcinoma

Scenario: pretreatment CT scan	Final level of agreement
A CT-ABDOMEN should be performed for preoperative assessment of GC	<b>Necessary (9.0)</b>
A CT-PELVIS should be performed for preoperative assessment of GC	<b>Necessary (7.0)</b>
A CT-CHEST should be performed for preoperative assessment of GC	<b>Appropriate (7.5)</b>
A CT scan for preoperative assessment should be performed with a gastric-specific distension/contrast protocol	Indeterminate (7.0)
A CT scan for preoperative assessment should be performed with a MDCT with a capability of 4 slices	Indeterminate (3.0)
A CT scan for preoperative assessment should be performed with a MDCT with a capability of 16 slices	Indeterminate (7.0)
A CT scan for preoperative assessment should be performed with a MDCT with a capability of 64 slices	<b>Appropriate (7.5)</b>
A CT scan for preoperative assessment should be performed with a MDCT with 3-mm thickness/slice	Indeterminate (7.0)
A CT scan for preoperative assessment should be performed with a MDCT with 5-mm thickness/slice	<b>Necessary (7.0)</b>
A CT scan for preoperative assessment should be performed with a MDCT with 7-mm thickness/slice	Indeterminate (5.0)

Results shown as final level of agreement, and the median appropriateness or necessity score on a scale of 1–9. Results in bold indicate agreement was met

CT computed tomography, GC gastric adenocarcinoma, NA not applicable, MDCT multidetector computed tomography

**Table 3** Appropriateness and necessity of practices in pretreatment staging laparoscopy and peritoneal lavage in the staging of gastric adenocarcinoma

Scenario: pretreatment staging laparoscopy	Final level of agreement
A staging laparoscopy should be performed for all patients planned for curative-intent resection of GC	Disagreement (6.0)
A staging laparoscopy should be performed for patients planned for curative-intent resection of GC with a suspected T1 lesion	Disagreement (3.0)
A staging laparoscopy should be performed for patients planned for curative-intent resection of GC with a suspected T2 lesion	Indeterminate (7.5)
A staging laparoscopy should be performed for patients planned for curative-intent resection of GC with a suspected T3 or T4 lesion	<b>Necessary (7.0)</b>
A staging laparoscopy should be performed for patients planned for curative-intent resection of GC if a multivisceral resection is planned	<b>Necessary (7.0)</b>
A staging laparoscopy should be performed for patients planned for curative-intent resection of GC when preoperative imaging shows positive lymph nodes	<b>Appropriate (8.0)</b>
A staging laparoscopy should be performed for patients planned for curative-intent resection before initiating perioperative chemotherapy	Indeterminate (7.5)
A staging laparoscopy should be performed for patients planned for curative-intent resection who had perioperative chemotherapy after the chemotherapy and before the resection	Indeterminate (7.0)
A staging laparoscopy should include a visual inspection of the stomach	<b>Necessary (8.0)</b>
A staging laparoscopy should include a visual inspection of the diaphragm	<b>Necessary (9.0)</b>
A staging laparoscopy should include a visual inspection of the liver	<b>Necessary (8.0)</b>
A staging laparoscopy should include a visual inspection of the ovaries	<b>Necessary (7.5)</b>
A staging laparoscopy should include an ultrasound inspection of the stomach	Indeterminate (4.5)
A staging laparoscopy should include an ultrasound inspection of the liver	Indeterminate (4.5)
A staging laparoscopy should include an ultrasound inspection of the lymph nodes	Indeterminate (4.5)
A staging laparoscopy should include an ultrasound inspection of the ovaries	Indeterminate (3.5)
A staging laparoscopy should include opening of the gastrocolic ligament to evaluate the celiac axis	<b>Uncertain (5.0)</b>
A staging laparoscopy should include sending peritoneal lavage for Papanicolaou stain examination	<b>Appropriate (8.0)</b>
A staging laparoscopy should include sending peritoneal lavage for IHC examination	Indeterminate (5.0)
A staging laparoscopy should include sending peritoneal lavage for PCR examination	Indeterminate (4.0)
A staging laparoscopy should include sending peritoneal lavage for tumor markers/immunoassay	Indeterminate (4.0)
Knowledge of peritoneal cytology is essential before definitive therapy	Indeterminate (7.0)

Results shown as final level of agreement, and the median appropriateness or necessity score on a scale of 1–9. Results in bold indicate agreement was met

GC gastric adenocarcinoma, IHC immunohistochemistry, PCR polymerase chain reaction, NA not applicable

physical examination may not require these staging modalities.

The foundation of the pretreatment workup is determination of TNM stage, so patients can be allocated toward the most appropriate stage-specific treatment. As expected, panelists agreed determination of T, N, and M is necessary for optimal treatment planning. The highest necessity score was for determination of M-stage, reflecting an important dichotomy in treatment decision making, as M1 patients are not appropriate candidates for curative-intent surgery [4, 5, 21]. Knowledge of metastatic disease would spare the patient an unnecessary laparotomy or futile resection, both of which are associated with high rates of morbidity and mortality [8, 9, 21].

EGD is the primary diagnostic investigation for evaluation of suspected GC. When performed properly, it provides valuable information such as location and duodenal and esophageal involvement and facilitates acquisition of biopsies [5]. Other guidelines strongly support the use of EGD during workup of GC. However, only 20–42 % of EGD reports are deemed adequate for surgical planning. Thus, surgeons are highly likely to repeat EGD before resection [22]. There is a paucity in the literature regarding the quality of EGD reports. Existing guidelines do not comment on what constitutes a complete EGD report [4–6]. Our panelists have provided recommendations for information to be included in EGD reports for GC.

CT scan is widely employed for pretreatment staging of GC. It is useful for examining local tumor extension, regional LN involvement, and the presence of peritoneal dissemination, liver metastases, and other sites of metastatic spread. The emphasis the panelists have placed on determining M-stage preoperatively underscores the importance of obtaining a staging CT scan. Previously established guidelines state that CT-abdomen is the modality of choice for the evaluation of local extension and distant metastases [3, 4]. Our panelists agreed, and additionally thought that evaluation of the pelvis is necessary for thorough evaluation of intraabdominal spread. CT-chest was considered appropriate to accurately stage proximal tumors and could be applied selectively, as the incidence of lung metastases is low [23].

EUS allows evaluation of the individual layers of the gastric wall [24, 25], with an overall pooled accuracy of 75 % [16]. Some guidelines support the use of EUS for staging of esophageal and GEJ tumors [4–6], to determine which patients may benefit from neoadjuvant regimens [5]. Otherwise, there is a lack of agreement between established guidelines concerning the utility of EUS, making its applicability uncertain [3–5]. Our panelists did not agree on the appropriateness of EUS before surgical resection, likely because EUS often does not change management strategies for resectable tumors by radiologic staging.

Laparoscopy is an effective, highly accurate modality for identifying metastasis in asymptomatic patients who would not benefit from resection [9, 17, 26, 27]. However, consistent with other groups, the panel noted that laparoscopy should be selectively applied to suspected T3–4 tumors, as the diagnostic yield of laparoscopy for suspected early GC is low because metastases are rare [28]; this is in agreement with existing guidelines [29]. Additionally, the panelists offer guidelines regarding content of the laparoscopy.

Positive peritoneal lavage is a poor prognostic indicator [30]; however, its value among practice guidelines remains controversial [3, 4]. Our panelists thought that performing peritoneal lavage is appropriate, but not necessary. An argument can be made, however, for performing peritoneal lavage, as the added time and morbidity to do so during a laparoscopy are insignificant. Future studies may examine how often these staging maneuvers are performed for GC patients.

## Conclusions

We used a RAND/UCLA method to establish appropriate and necessary practices in the pretreatment staging of GC, as well as how these investigations can optimally be performed. Accurate staging is of paramount importance in stratifying patients into optimal stage-specific treatments to maximize survival. The panel's recommendations are useful guidelines when considering which investigations to employ in pretreatment staging.

**Acknowledgments** This research is funded by the Canadian Cancer Society (Grant #019325). Dr. Coburn (Career Scientist Award) and Dr. Paszat have received funding through the Ontario Ministry of Health and Long-Term Care. Dr. Law is supported by the Hanna Family Research Chair in Surgical Oncology. We thank the Gastric Cancer Processes of Care Expert Panel for their time, insight, and dedication to this project: Tarios Bekaii-Saab MD, Ian Chau MD, Neal Church MD, Daniel Coit MD, Christopher H. Crane MD, Craig Earle MD, MSc, Paul Mansfield MD, Norman Marcon MD, Thomas Minder MD, Sung Hoon Noh MD, PhD, Geoff Porter MD, MSc, Mitchell C. Posner MD, Vivek Prachand MD, Takeshi Sano MD, Cornelis JH Van de Velde MD, PhD, and Sandra Wong MD.

## References

1. Yabroff KR, Lamont EB, Mariotto A, et al. Cost of care for elderly cancer patients in the United States. *J Natl Cancer Inst.* 2008;100:630–41.
2. Edge SB, Compton CC, Fritz AG, et al. *AJCC cancer staging manual.* New York: Springer; 2010.
3. Van Cutsem E, Dicato M, Geva R, et al. The diagnosis and management of gastric cancer: expert discussion and recommendations from the 12th ESMO/World Congress on

- Gastrointestinal Cancer, Barcelona, 2010. *Ann Oncol.* 2011;22(suppl 5):v1–9.
4. Scottish Intercollegiate Guidelines Network. Management of oesophageal and gastric cancer: a national clinical guideline. Edinburgh: NHS Quality Improvement Scotland; 2006.
  5. NCCN clinical practice guidelines in oncology: gastric cancer. In: National Comprehensive Cancer Network website, Edition 2011.
  6. Allum WH, Blazeby JM, Griffin SM, et al. Guidelines for the management of oesophageal and gastric cancer. *Gut.* 2011;60:1449–72.
  7. Coburn NG, Lourenco LG, Rossi SE, et al. Management of gastric cancer in Ontario. *J Surg Oncol.* 2010;102:54–63.
  8. Karanicolas PJ, Elkin EB, Jacks LM, et al. Staging laparoscopy in the management of gastric cancer: a population-based analysis. *J Am Coll Surg.* 2011;213:644–51 (51 e1).
  9. Smith BR, Stabile BE. Gastric adenocarcinoma: reduction of perioperative mortality by avoidance of nontherapeutic laparotomy. *J Gastrointest Surg.* 2007;11:127–32.
  10. Shekelle PG, Park RE, Kahan JP, et al. Sensitivity and specificity of the RAND/UCLA Appropriateness Method to identify the overuse and underuse of coronary revascularization and hysterectomy. *J Clin Epidemiol.* 2001;54:1004–10.
  11. Bilimoria KY, Raval MV, Bentrem DJ, et al. National assessment of melanoma care using formally developed quality indicators. *J Clin Oncol.* 2009;27:5445–51.
  12. Poston GJ, Adam R, Alberts S, et al. OncoSurge: a strategy for improving resectability with curative intent in metastatic colorectal cancer. *J Clin Oncol.* 2005;23:7125–34.
  13. Fitch KBS, Aguilar MS, Burnand B, LaCalle JR, Lazaro P, van het Loo M, McDonnell J, Vader J, Kahan JP. The RAND/UCLA appropriateness method user's manual: RAND 2001.
  14. Dixon M, Seevaratnam R, Wirtzfeld D, et al. A RAND/UCLA appropriateness study of the management of familial gastric cancer. *Ann Surg Oncol.* 2013;20(2):533–41.
  15. Seevaratnam R, Cardoso R, McGregor C, et al. How useful is preoperative imaging for tumor, node, metastasis (TNM) staging of gastric cancer? A meta-analysis. *Gastric Cancer.* 2012;15(suppl 1):3–18.
  16. Cardoso R, Coburn N, Seevaratnam R, et al. A systematic review and meta-analysis of the utility of EUS for preoperative staging for gastric cancer. *Gastric Cancer.* 2012;15(suppl 1):19–26.
  17. Leake PA, Cardoso R, Seevaratnam R, et al. A systematic review of the accuracy and indications for diagnostic laparoscopy prior to curative-intent resection of gastric cancer. *Gastric Cancer.* 2012;15(suppl 1):38–47.
  18. Leake PA, Cardoso R, Seevaratnam R, et al. A systematic review of the accuracy and utility of peritoneal cytology in patients with gastric cancer. *Gastric Cancer.* 2012;15(suppl 1):27–37.
  19. Brook RH, Chassin MR, Fink A, et al. A method for the detailed assessment of the appropriateness of medical technologies. *Int J Technol Assess Health Care.* 1986;2:53–63.
  20. Kahan JP, Bernstein SJ, Leape LL, et al. Measuring the necessity of medical procedures. *Med Care.* 1994;32:357–65.
  21. Mahar AL, Coburn NG, Singh S, et al. A systematic review of surgery for non-curative gastric cancer. *Gastric Cancer* 2012;15(Suppl 1):S125–37.
  22. Ravindran N, Mahar AL, Law CH, Coburn NG, Timmouth J. Esophagogastroduodenoscopy (EGD) reporting for preoperative management of gastric cancer: evaluation of quality. Society for Surgery of the Alimentary Tract—Digestive Disease Week, Chicago, 2011.
  23. Kemp CD, Kitano M, Kerkar S, et al. Pulmonary resection for metastatic gastric cancer. *J Thorac Oncol.* 2010;5:1796–805.
  24. Puli SR, Reddy JBK, Bechtold ML, et al. How good is endoscopic ultrasound for TNM staging of gastric cancers? A meta-analysis and systematic review. *World J Gastroenterol.* 2008;14:4011–9.
  25. Takemoto T, Yanai H, Tada M, et al. Application of ultrasonic probes prior to endoscopic resection of early gastric cancer. *Endoscopy.* 1992;24(suppl 1):329–33.
  26. Sarela AI, Lefkowitz R, Brennan MF, et al. Selection of patients with gastric adenocarcinoma for laparoscopic staging. *Am J Surg.* 2006;191:134–8.
  27. Burke EC, Karpeh MS, Conlon KC, et al. Laparoscopy in the management of gastric adenocarcinoma. *Ann Surg.* 1997;225:262–7.
  28. Kumai K, Otani Y, Aiura K, et al. Distant metastasis in early gastric cancer. *Gastroenterology.* 1998;114(suppl 1):A631.
  29. Practice/clinical guidelines: diagnostic laparoscopy guidelines. Society of American Gastrointestinal and Endoscopic Surgeons (SAGES). 2007.
  30. Bentrem D, Wilton A, Mazumdar M, et al. The value of peritoneal cytology as a preoperative predictor in patients with gastric carcinoma undergoing a curative resection. *Ann Surg Oncol.* 2005;12:347–53.