# Geographic variation in follow-up after rectal cancer surgery

DAVID M. NEILS<sup>1</sup>, KATHERINE S. VIRGO<sup>1,3</sup>, WALTER E. LONGO<sup>4</sup>, KENICHI ODE<sup>5</sup>, RICCARDO A. AUDISIO<sup>6</sup>, UMAR S. SHARIFF<sup>7</sup>, TRIFONAS PAPETTAS<sup>7</sup>, ALAINE E. McGARRY<sup>2</sup>, STEVEN R. GAMMON<sup>1</sup> and FRANK E. JOHNSON<sup>1,3</sup>

Departments of <sup>1</sup>Surgery and <sup>2</sup>Internal Medicine, Saint Louis University Medical Center, P.O. Box 15250, 3635 Vista Ave., St. Louis, MO 63110-0250; <sup>3</sup>Department of Surgery, Department of Veterans Affairs Medical Center, 915 N. Grand Blvd., St. Louis, MO 63106; <sup>4</sup>Department of Surgery, Yale University School of Medicine, 330 Cedar St., LH 118, New Haven,

CT 06520, USA; <sup>5</sup>Education Centre, Royal Lancaster Infirmary, Ashton Road, Lancaster, LA1 4RR;

<sup>6</sup>Department of General Surgery, Whiston Hospital - Prescot, Merseyside L35 5DR;

<sup>7</sup>Department of Surgery, Royal Hallamshire Hospital, Glossop Road, Sheffield S10 2JP, UK

Received August 23, 2006; Accepted October 20, 2006

Abstract. Most patients with rectal cancer are treated with curative-intent surgery; adjuvant chemotherapy and radiation are often used as well. A recent survey of members of the American Society of Colon and Rectal Surgeons (ASCRS) revealed considerable variation in surveillance intensity after primary treatment. We evaluated whether geographic factors may be responsible for the observed variation. Vignettes of hypothetical patients and a questionnaire based on the vignettes were mailed to the 1782 members of ASCRS. Repeated-measures analysis of variance was used to compare practice patterns, as revealed by the responses, according to US Census Regions and Divisions, Metropolitan Statistical Areas (MSA), and state-specific managed care organization (MCO) penetration rates. There was significant variation in surveillance intensity according to the US Census Region and Division in which the surgeon practiced. Non-US respondents employed CT of the abdomen and pelvis, chest radiography, and colonoscopy significantly more often than US respondents. MSA was not a significant source of variation. Surveillance patterns varied significantly by MCO penetration rate for office visits and CT of the abdomen and pelvis but not for other modalities. The US Census Region and Division in which the surgeon practices have a significant effect on surveillance intensity following completion of primary curative-intent therapy for rectal cancer patients. The MSA in which the surgeon practices does not affect surveillance intensity significantly and MCO penetration rate affects follow-up intensity minimally. All significant differences are clinically rather modest, however. These data should be useful in the design of controlled trials on this topic.

## Introduction

In the mid-nineteenth century effective anesthetics were introduced into clinical practice for the first time in history, permitting the emergence of surgery as a widely applicable treatment for visceral cancers (1). The results of proctectomy for rectal cancer have steadily improved since then, as measured by rates of operative mortality, morbidity, and long-term cure. The roles of adjuvant chemotherapy and radiation are well established and evolution of surgical technique has continued to yield innovative approaches such as laparoscopic proctectomy (2) and total mesorectal resection (3). Modern medical practice also features an increased appreciation of societal expectations and patient desires. Improved qualityassurance mechanisms and new business models have resulted in altered patient flow patterns into and through health care systems. Wasteful, ineffective care has been eliminated in some instances. Analysis of large numbers of patients through computer-based data sets such as those of the National Cancer Institute (Surveillance, Epidemiology, and End Results Program), the US National Center for Health Statistics of the Centers for Disease Control (4), the Department of Veterans Affairs (National Surgical Quality Improvement Program) (5) and various national health care data sets from other countries has contributed insights into management of common disorders such as rectal cancer.

Many conditions, and measures used to diagnose and treat them, have been subjected to outcome analysis. Wennberg and Gittlesohn demonstrated the utility of scrutinizing smallarea variation in medical practice several decades ago (6). Although such variation in clinical practices is not necessarily interpreted as evidence of inappropriate care (7,8) it is a common subject of analysis. Examples include appropriateness of hysterectomy, extraction of impacted molars, carotid endarterectomy, and endoscopy (9). Several years ago we reported how geographic factors affect the intensity of post-treatment patient surveillance after initial curative-intent

*Correspondence to:* Dr Frank E. Johnson, Department of Surgery, Saint Louis University Hospital, 3635 Vista Ave. at Grand Blvd., P.O. Box 15250, St. Louis, MO 63110-0250, USA

*Key words:* follow-up, outcomes, postoperative, rectal carcinoma, surveillance, geography

therapy for colon cancer (10). We recently conducted a survey of members of the American Society of Colon and Rectal Surgeons (ASCRS) to determine how these highly experienced, highly credentialed experts follow their own patients after primary therapy for rectal cancer. Not surprisingly, considerable variation in the intensity of surveillance was documented (11). This prompted us to analyze whether geographic factors could account for the observed variation in practice. By relating published managed-care organization (MCO) penetration rates to the known practice locations of the surveyed surgeons, we were also able to estimate the effect MCOs have on follow-up intensity for rectal cancer patients. The results of these analyses are reported here.

## Materials and methods

Surveys were mailed to the 1795 members of the American Society of Colon and Rectal Surgeons (ASCRS), with the permission of ASCRS, in 2002. The initial mailing was followed by two subsequent mailings to members who did not respond to previous inquiries. The mailing consisted of a cover letter, the survey instrument, and a stamped return envelope. The survey had several parts, the first of which sought information about the surgeon's demographics, practice characteristics, and educational background. Next the survey attempted to quantify how frequently the surgeon employed office visit, complete blood count (CBC), liver function tests, serum carcinoembryonic antigen level (CEA), colonoscopy, flexible sigmoidoscopy, chest radiograph, intrarectal ultrasound, computed tomography (CT) of abdomen/pelvis, CT of chest, MRI of abdomen/pelvis, CEA scan, whole body PET scan (fluorodeoxyglucose), and bone scan for patient follow-up post-treatment using idealized, simplified patient vignettes. The vignettes featured generally healthy patients with varying TNM stages and treatments (local therapy of Stage I rectal carcinoma, radical surgery of Stage I rectal carcinoma, radical surgery of Stage II rectal carcinoma, radical surgery of Stage III rectal carcinoma, with or without adjuvant treatment), and requested information about follow-up for the first 5 postoperative years. The final portion of the survey measured each physician's motivation in performing postoperative surveillance by having the physician assign values on a Likert scale for potential motivating factors such as early detection of cancer recurrence, promotion of patient education, avoidance of malpractice entanglements, and enhancing patient referrals. The survey instrument is available on the internet (12).

Data from the responses were entered into the Statistical Package for the Social Sciences (SPSS), a computer program permitting advanced statistical analysis on large amounts of data. Using SPSS, correlation analysis was carried out to determine if the physician responses were indeed independent as is necessary for the use of many advanced statistical methods. Finally, assuming that correlation analysis would reveal dependence among responses, the general linear model of repeated-measures analysis of variance was selected to measure the effects of the geographic location of the surgeon on patient surveillance. In instances where sphericity was rejected, the lower-bound value of epsilon was used to calculate values of p. Bonferroni's test was used to conduct *post hoc* analyses.

This study examined variation in physician-reported follow-up following curative-intent rectal cancer surgery. Four specific geographic measures were examined. Practices in the four US Census Regions and nine Divisions (plus an additional Region or Division comprised of foreign respondents) were analyzed to assess large-area variation. Consolidated metropolitan statistical areas (MSAs) were analyzed to assess smallarea variation among large cities with sufficient numbers of respondents to permit valid analyses. Primary MSAs were used to determine variation in urban versus rural areas. To assess the effect of MCO penetration rate on follow-up intensity, the published MCO penetration rates for each US Zip Code (13) were correlated with each surgeon's practice location. In presenting the data in the tables, the means and standard deviations were used from simple descriptive statistics generated before running the repeated measures analysis of variance.

## Results

There were 566 responses (32% response rate). Of these, 219 were not included in the results because they were incomplete, or the respondent did not perform surgery or did not perform follow-up. There were 346 surgeons who provided evaluable data. One respondent was excluded from the analysis as a result of extreme values reported for all testing modalities. This report concerns the remaining 345 evaluable responses. For purposes of this report, we provide data concerning the self-reported follow-up for patients with TNM stage I rectal cancer treated with radical surgery in postoperative year 1 only. However, all repeated measures analysis of variance calculations include all TNM stages and all postoperative years. Data derived from the other three vignettes and from other years in the TNM stage I vignette show similar patterns (data not shown). Correlation analysis (data available upon request) showed that all measurements were highly correlated (r>0.7). Only modalities that were used by >20% of respondents were included in the analysis in order to ensure adequate statistical power ( $\geq 0.80$ ). Thus, office visit, CBC, liver function tests, CEA, colonoscopy, flexible sigmoidoscopy, chest X-ray, CT of the abdomen and pelvis, and intrarectal ultrasound qualified for further analysis. The modalities not included were CT of the chest (used by 11% of respondents), MRI of the abdomen and pelvis (7%), CEA scan (5%), PET scan (7%), and bone scan (6%).

To assess geographic variation in the US and abroad, the data were initially divided into US Census Regions and Divisions (Fig. 1). Respondents from Puerto Rico and Washington, DC, were grouped in the Southern Region and South Atlantic Division. Respondents from Micronesia were included in the Western Region and Pacific Division. All foreign respondents were grouped in a separate foreign category. Analysis of the Census Region data (Table I) revealed a statistically significant (p<0.05) main effect of Census Region on the frequency of utilization of office visit, CBC, CEA, colonoscopy, flexible sigmoidoscopy, chest X-ray, intrarectal ultrasound and CT of the abdomen and pelvis. All of these modalities, except intrarectal ultrasound, were adequately powered ( $\geq 0.80$ ). In addition, significant (p<0.05) main effects of years postsurgery on frequency of utilization of all testing modalities were noted. Significant two-way



Figure 1. Picture showing the various regions and divisions courtesy of the United States Census Bureau.

Region	Office visit <sup>b</sup>	CBC <sup>b</sup>	LFTs	CEA <sup>a</sup>	Colonoscopy <sup>c</sup>	Flexible sigmoidoscopy <sup>a</sup>	Chest X-ray <sup>c</sup>	Intrarectal ultrasound <sup>a</sup>	CT abdomen/ pelvis <sup>c</sup>	N
Northeast	3.4±1.2	1.1±1.4	1.0±1.2	2.8±1.5	0.8±0.4	1.0±1.4	0.6±0.6	0.1±0.4	0.5±0.5	65
South	3.9±1.2	1.2±1.6	1.1±1.5	3.1±2.0	0.9±0.4	$0.8 \pm 1.4$	0.7±0.9	0.3±0.8	0.4±0.5	82
Midwest	3.7±1.0	1.1±1.5	1.0±1.5	2.8±1.7	0.9±0.6	1.3±1.6	$0.7\pm0.8$	0.4±1.0	0.3±0.5	55
West	3.3±1.1	1.1±1.1	1.1±1.1	2.2±1.6	$0.8 \pm 0.4$	0.9±1.4	0.6±0.6	0.1±0.4	0.2±0.4	37
Foreign	3.9±1.9	1.8±1.7	1.5±1.6	2.8±1.6	1.0±0.7	0.6±1.1	1.2±1.0	0.5±1.0	0.7±0.7	107
Total	3.7±1.5	1.3±1.6	1.2±1.5	2.8±1.7	0.9±0.5	0.9±1.4	0.8±0.9	0.3±0.8	0.5±0.6	346

Table I. Frequency of utilization of nine testing modalities by US Census Region.

Data are presented as mean  $\pm$  standard deviation. The numbers in each cell indicate the number of times a particular modality is recommended in postoperative year 1. All means and standard deviations pertain to the follow-up of patients with TNM stage I tumors who underwent radical surgery. CBC, complete blood count; LFTs, liver function tests; CEA, serum carcinoembryonic antigen level; CT, computerized tomography. a Statistically significant main effect at p<0.05. b Statistically significant main effect at p<0.01. c Statistically significant main effect at p<0.01.

interactions (p<0.05) between postoperative year and Census Region were noted for CBC and chest X-ray (power  $\geq$ 0.80). Significant two-way effects (p<0.05) were also noted for year postsurgery for office visits, flexible sigmoidoscopy, and intrarectal ultrasound; however, only intrarectal ultrasound had adequate power ( $\geq 0.80$ ). Though test utilization for no one Region was always the highest or lowest, *post hoc* analysis revealed significantly greater utilization of CT of the abdomen and pelvis, chest radiography, and colonoscopy for the non-US respondents compared to the other four Regions.

Division	Office visit <sup>a</sup>	CBC <sup>a</sup>	LFTs	CEAª	Colono- scopy <sup>b</sup>	Flexible sigmoido- scopy <sup>a</sup>	Chest X-ray <sup>c</sup>	Intrarectal ultrasound <sup>c</sup>	CT abdomen/ pelvis <sup>c</sup>	Ν
New England	3.9±0.7	0.7±1.0	0.7±0.8	3.1±1.4	0.8±0.4	0.8±1.3	0.6±0.5	0.1±0.5	0.3±0.5	18
Middle Atlantic	3.2±1.3	1.3±1.5	1.1±1.3	2.7±1.5	0.9±0.4	1.1±1.4	0.6±0.6	0.1±0.4	0.6±0.6	47
South Atlantic	3.8±1.0	1.3±1.7	1.3±1.7	2.9±1.8	0.9±0.3	$1.0 \pm 1.7$	0.8±0.9	0.5±1.0	0.5±0.6	51
East North Central	3.7±1.1	1.1±1.4	1.2±1.5	3.1±1.5	0.9±0.7	1.4±1.6	0.8±0.9	0.1±0.4	0.4±0.5	38
East South Atlantic	3.8±0.5	1.1±1.8	1.1±1.8	3.3±1.4	0.5±0.5	0.8±1.0	0.4±0.5	0.3±0.5	0.1±0.4	8
West North Central	3.7±0.5	1.1±1.7	0.7±1.4	2.1±2.0	0.9±0.4	1.1±1.6	0.4±0.5	1.0±1.6	0.2±0.4	17
West South Atlantic	4.1±2.0	0.8±1.3	0.5±0.8	3.4±2.6	0.9±0.3	0.4±0.7	0.8±0.9	0.0±0.0	0.3±0.5	23
Mountain	3.3±1.0	0.8±0.9	0.8±0.7	2.5±1.5	0.9±0.4	0.3±0.5	0.6±0.5	0.3±0.7	0.4±0.5	9
Pacific	3.3±1.1	1.2±1.1	1.2±1.2	2.2±1.6	0.7±0.5	1.1±1.5	0.6±0.6	0.1±0.3	0.1±0.3	28
Foreign	3.8±1.9	1.8±1.7	1.5±1.6	2.8±1.6	1.0±0.7	0.6±1.1	1.2±1.0	0.5±1.0	0.7±0.7	107
Total	3.7±1.5	1.3±1.6	1.2±1.5	2.8±1.7	0.9±0.5	0.9±1.4	0.8±0.9	0.3±0.8	0.5±0.6	346

Table II. Frequency of utilization of nine testing modalities by US Census Division.

Data are presented as mean  $\pm$  standard deviation. The numbers in each cell indicate the number of times a particular modality is recommended in postoperative year 1. All means and standard deviations pertain to the follow-up of patients with TNM stage I tumors who underwent radical surgery. CBC, complete blood count; LFTs, liver function tests; CEA, serum carcinoembryonic antigen level; CT, computerized tomography. a Statistically significant main effect at p<0.05. b Statistically significant main effect at p<0.01. c Statistically significant main effect at p<0.001.

Table III. Frequency of utilization of nine testing modalities by consolidated MSA.

CMSA	Office visit	CBC	LFTs	CEA	Colono- scopy	Flexible sigmoido- scopy	Chest X-ray	Intrarectal ultrasound	CT abdomen/ pelvis	Ν
Chicago-Gary-Kenosha	3.6±0.8	1.4±1.6	1.6±1.6	2.8±1.5	0.6±0.5	1.7±1.9	0.7±0.7	0.2±0.4	0.2±0.4	10
New York City-North New Jersey- Long Island	3.2±1.1	1.4±1.5	1.4±1.5	2.9±1.3	0.7±0.5	0.9±1.0	0.6±0.7	0.1±0.3	0.4±0.5	11
Other CMSA	3.7±1.2	1.1±1.4	1.0±1.4	2.8±1.8	0.9±0.4	1.0±1.5	0.7±0.8	0.3±0.8	0.4±0.5	160
Non-CMSA	3.5±1.2	1.1±1.3	1.1±1.3	3.0±1.7	0.7±0.5	0.7±1.3	0.6±0.6	0.2±0.7	0.4±0.5	47
Total	3.6±1.8	1.1±1.4	1.1±1.4	2.8±1.7	0.8±0.5	1.0±1.5	$0.7\pm0.7$	0.3±0.7	0.4±0.5	228

Data are presented as mean  $\pm$  standard deviation. The numbers in each cell indicate the number of times a particular modality is recommended in postoperative year 1. All means and standard deviations pertain to the follow-up of patients with TNM stage I tumors who underwent radical surgery. Restricted to U.S. respondents only due to the lack of data for foreign respondents. Also excludes the Northern Mariana Islands and Puerto Rico. CBC, complete blood count; LFTs, liver function tests; CEA, serum carcinoembryonic antigen level; CT, computerized tomography; MSA, metropolitan statistical area. There were no statistically significant main effects of consolidated MSA on testing frequency for any modalities.

Analysis of the Census Division data (Table II) revealed statistically significant (p<0.05) main effects of Census Division on the frequency of utilization of all tests except LFTs. A significant (p<0.05) main effect, as expected, was detected for years postsurgery for all of the examined modalities. All of these main effects had adequate power ( $\geq$ 0.80). Significant (p<0.05) two-way interactions of postoperative year and Census Division were noted for CBC, chest X-ray and intrarectal ultrasound (power  $\geq$ 0.80). *Post hoc* analysis revealed several significant (p<0.01) effects of foreign division for CT of the abdomen and pelvis, chest radiography, and intrarectal ultrasound. In general, the greatest differences were between the Western divisions and the foreign division.

To further evaluate geographic variation in surveillance test utilization, consolidated MSAs were analyzed (Table III). Those consolidated MSAs with  $\geq 10$  respondents were included, with all other consolidated MSAs aggregated as 'other' (urban; n=160) or non-MSAs (rural: n=47). Only two had

	Office visit	CBC	LFTs	CEA	Colonoscopy	Flexible sigmoidoscopy	Chest X-ray	Intrarectal ultrasound	CT abdomen/ pelvis	N
MSA	3.6±1.2	1.1±1.4	1.0±1.4	2.8±1.8	0.9±0.4	1.1±1.5	0.7±0.8	0.3±0.7	0.4±0.5	175
Non-MSA	3.5±1.2	1.1±1.3	1.1±1.3	3.0±1.7	0.7±0.5	0.7±1.3	0.6±0.6	0.2±0.7	0.4±0.5	45
Total	3.6±1.2	1.1±1.4	1.1±1.4	2.8±1.7	0.8±0.5	1.0±1.5	0.7±0.7	0.3±0.7	0.4±0.5	220

Table IV. Frequency of utilization of nine testing modalities by MSA (urban centers) vs. non-MSA (rural areas).

Data are presented as mean ± standard deviation. The numbers in each cell indicate the number of times a particular modality is recommended in postoperative year 1. All means and standard deviations pertain to the follow-up of patients with TNM stage I tumors who underwent radical surgery. Restricted to U.S. respondents only due to the lack of data for foreign respondents. Also excludes the Northern Mariana Islands and Puerto Rico. CBC, complete blood count; LFTs, liver function tests; CEA, serum carcinoembryonic antigen level; CT, computerized tomography; MSA, metropolitan statistical area. There were no statistically significant main effects of consolidated MSA on testing frequency for any modalities.

Table V. Frequency of test utilization based upon MCO penetration rate.

MCO penetration <sup>b</sup> rate (percent)	Office visit <sup>a</sup>	CBC	LFTs	CEA	Colono- scopy	Flexible sigmoido- scopy	Chest X-ray	Intrarectal ultrasound	CT abdomen/ pelvis <sup>a</sup>	Ν
0-29	3.9±1.1	0.9±1.3	0.9±1.3	3.1±1.9	0.8±0.5	0.9±1.4	0.7±0.8	0.2±0.6	0.3±0.5	87
29-38	3.5±1.2	1.3±1.6	1.1±1.5	2.7±1.7	0.9±0.4	1.3±1.7	0.7±0.8	0.4±0.8	0.5±0.6	78
38-42	3.4±1.2	1.1±1.3	1.1±1.3	2.6±1.5	0.8±0.4	0.9±1.3	0.6±0.6	0.2±0.6	0.3±0.5	70
Total	3.6±1.2	1.1±1.4	1.0±1.4	2.8±1.7	0.8±0.5	1.00±1.5	0.7±0.7	0.2±0.7	0.4±0.5	235

Data are presented as mean ± standard deviation. The numbers in each cell indicate the number of times a particular modality is recommended in postoperative year 1. All means and standard deviations pertain to the follow-up of patients with TNM stage I tumors who underwent radical surgery. Restricted to U.S. respondents only due to the lack of data for foreign respondents. Also excludes the Northern Mariana Islands and Puerto Rico. CBC, complete blood count; LFTs, liver function tests; CEA, serum carcinoembryonic antigen level; CT, computerized tomography. <sup>a</sup>Statistically significant main effect at p<0.05. <sup>b</sup>National Research Corporation Market Guide (http://www.nationalresearch. com or 1-800-388-4264).

≥10 respondents: New York, NY-North New Jersey-Long Island, CT (n=11) and Chicago, IL-Kenosha, WI-Gary, IN (n=10). There were no significant main or interaction effects for MSA. Again, as expected, there were significant (p<0.05) main effects of years postsurgery on frequency of utilization of all surveillance modalities. All modalities except for colonoscopy and intrarectal ultrasound had adequate power (≥0.80). To evaluate urban versus rural follow-up practices, MSAs were compared with non-MSAs (Table IV). There were no significant main effects attributable to this variable. Again, as expected, significant (p<0.05) year postsurgery main effects were detected for all modalities, and all had adequate power (≥0.80).

Finally, to evaluate the effect of managed care on follow-up practices, the data were stratified by MCO penetration rates and divided into three groups of similar size (Table V). These revealed significant (p<0.05) but inadequately powered main effects for office visits (power 0.77) and CT of the abdomen and pelvis (power 0.68). Again, as expected, significant (p<0.05) main effects were detected for frequency of utilization of all modalities based upon years postsurgery, and all had adequate power ( $\geq 0.80$ ).

#### Discussion

The World Health Organization estimated that there were 56.6 million deaths in the world in 2001 (14). About 7.4 million were due to cancer. Cancer now exceeds heart disease in the US as the leading cause of death for people younger than 85 (4). In wealthy countries, colorectal cancer is a common cause of death. The estimated mortality rate in the US from rectal cancer is about 27 per 100,000 population per year for males and 19 per 100,000 population per year for females (15). It was estimated to account for approximately 3% of new cancer cases in the United States in 2005 (4). Surgery is the primary treatment modality. One method to improve clinical results after primary treatment is careful patient followup. However, the current published strategies for following patients vary substantially in intensity (16). Thus, there is still controversy as to the value and efficacy of long-term follow-up in improving the survival for these patients (17). Cancer patient surveillance after curative-intent primary treatment is a large problem and inadequately studied (18). The US National Cancer Institute and the Centers for Disease Control and Prevention estimated that there are about 10 million

cancer survivors in the US (19). The American Cancer Society estimates that about 1.4 million new cancer cases will occur in the US in 2005 and that the current expected 5-year overall survival rate is 65% (4). Estimating conservatively that 75% of the 1.4 million new cases are initially treated with curative intent in order to generate the 65% long-term survival rate, it is reasonable to conclude that 1 million US citizens are treated with curative intent annually at present. About 40,000 new rectal cancers are among the 1.4 million total new cancers and about 85% of these (35,000) are treated with curative intent and entered into a follow-up regimen of some sort.

A prior study determined the follow-up practice patterns of a large, diverse group of surgeons, all with extensive credentials as experts, who provide care for many patients with rectal cancer (11). The data disclosed considerable variation in follow-up intensity. In the present analysis, we sought to determine whether geographic factors could account for the variation.

Several randomized prospective trials examining various follow-up protocols after curative resection for colon cancer have been conducted. Four (20-23) of these found no statistically significant 5-year survival advantage for the more intensely followed group while two found a statistically significant (p<0.05) advantage (24,25). No definitive conclusion can be drawn from these trials individually due to lack of statistical power. Meta-analyses (26-28) of these trials have been undertaken, all of which suggested that intensive followup detects more recurrences earlier and can significantly increase the 5-year survival of patients. Unfortunately, all of the meta-analyses combine studies with highly variable follow-up protocols. Therefore, no definitive conclusions can be drawn as to the optimal strategy. Large randomized prospective studies are still needed to reach a definitive answer; such trials are currently in progress but will not be mature for several years (10).

An evaluation of published follow-up protocols for colon cancer demonstrated that the charges per patient for 5 years of follow-up varied from \$910 to \$26,717, a 28-fold difference (29). Rectal cancer follow-up tends to be more expensive and considerable variation in protocol intensity exists, making the economic differences at least as important as for colon cancer. A Markov analysis of CEA level monitoring showed an increase in life expectancy for the CEAmonitored group of seven days, which translated into a marginal cost-effectiveness of \$86,227 per additional quality adjusted life year (30). The potential economic impact of implementing rigorous follow-up regimens without scientific support is apparent.

In addition to questions regarding survival advantages and financial feasibility of rectal cancer follow-up, it is also necessary for the physician to consider the patient's psychological well-being. Survey results (31,32) show that patients describe follow-up as reassuring and positive, but there are reported disadvantages to follow-up such as stress and a reminder of the severity of their illness. Though follow-up is generally viewed in a positive light based on psychological factors, it is not without its disadvantages.

Because there is a lack of consensus in the literature as to the most efficacious follow-up protocol balancing 5-year survival benefits, financial costs, and psychological concerns, and because there are many tests available for follow-up, variation in follow-up practices might be expected. Tumor stage and years postsurgery have been shown to account for some of the differences in follow-up practices for rectal cancer (11). A third plausible source of variation could be related to the location of the physician's practice, as has been demonstrated in both lung (33) and prostate cancer (34). Another plausible source of variation could be the regional effects of training programs, since physicians tend to practice in the state where they received training (35).

The ideal surveillance strategy for rectal carcinoma patients who have undergone potentially curative resection is not known, and we have shown that the management of such patients varies widely among practitioners (11). Much of the variation in the care delivery interventions of physicians is ascribable to the poor quality of evidence concerning efficacy, effectiveness, and efficiency of a particular intervention. We believe this is the most likely explanation for the diverse surveillance strategies documented in our survey. Overuse, underuse, and misuse of medical interventions has been identified by the Institute of Medicine of the National Academy of Sciences as a large, expensive problem (36). The presence of considerable variation in a particular medical practice suggests that some of the medical decisions are inappropriate and has been attributed to lack of consensus among physicians regarding indications for diagnostic tests and therapeutic measures (37). Identifying the reasons can benefit society by providing opportunities to avoid wasting resources (when the cost of a particular practice is too high to warrant its use) and opportunities to improve health (when the benefits of a particular practice are great enough to justify its expense). In rectal carcinoma care, the economic implications of follow-up programs are large because of the size of the patient population, the number of available surveillance modalities and their costs. Among these costs are those attributable to pursuit of false-positive results, as emphasized in a recent Wall Street Journal article (38).

A report on the intensity of colorectal cancer follow-up based upon Surveillance, Epidemiology, and End Results (SEER) registry and Medicare claims data noted a marked variability due to geographic factors (39). The present study, which employed self-reported practice data with much sharper focus on pertinent variables, suggests that variation is not as large. Liff et al demonstrated an urban-rural difference in tumor stage at diagnosis (40), but our study disclosed no significant urban-rural effect on the follow-up protocols used by members of ASCRS. Our finding makes intuitive sense because the main reason one would expect to see rural-urban variation is the relative paucity of highly specialized physicians and high technology equipment in rural areas (40). Since our survey targeted these highly credentialed surgical specialists, most of whom practice in urban centers, it is not surprising that there was little urban-rural discrepancy. However, the results would likely be different if all physicians who carry out follow-up had been included in our survey.

There was minimal variation in self-reported test utilization related to MCO penetration rate. Keating *et al* reported that managed-care penetration rate does not affect the quality of care for Medicare beneficiaries for most indicators (41) although it has been reported that MCO penetration rate reduces the frequency of preventable hospitalizations (42). The American Society of Clinical Oncology (ASCO) is invested in measuring the processes of cancer care. ASCO sponsored development of the Quality Oncology Practice Initiative (QOPI) to this end and reported preliminary results recently (43). QOPI identified statistically significant variation among practitioners for many indicators. Dilts, in the companion editorial, emphasized the power and importance of geographic variation in assessing quality (44) and we concur wholeheartedly.

Surveys of this type have intrinsic weaknesses (45). One is the time it takes to collect, analyze and publish these data, making it unsuitable for evaluating rapidly developing technologies. Another is recall bias on the part of the responding surgeon. We believe this is likely to have occurred in this survey. Another is response bias in the queried sample that may lead to results that are not truly representative of the group. In spite of these potential biases, surveys of this type are often the only way to obtain a snapshot of practice patterns at a given time.

In conclusion, this examination of the practice habits of highly qualified expert clinicians identified differences related to geographic factors in the self-reported follow-up intensity for rectal cancer patients. The variation was related to population density. One possible cause of this regional variation could be the effects of local professional organizations. Because well over half of physicians remain in the states in which they received their graduate medical education (35,46), another possible source of this regional variation could be the effect of teaching institutions such as medical schools, residency training programs, and major cancer centers upon the physicians practicing in the area around them. A more likely source of variation, however, is the lack of evidence supporting any particular strategy (18). A randomized controlled trial with adequate statistical power, comparing rational alternate follow-up strategies, will probably be required to decrease variation in practice. Current evidence clearly has failed to accomplish this. The data outlined in this report should be valuable in designing the trial arms.

#### Acknowledgements

No informed consent was required. No financial support from external sources was involved in the conduct of this research. This work was presented in abstract form at ASCO (2005), World Congress of Gastroenterology (2005), Association for Academic Surgery (2006), and ASPO (2006).

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