



## CT Colonography in 2009

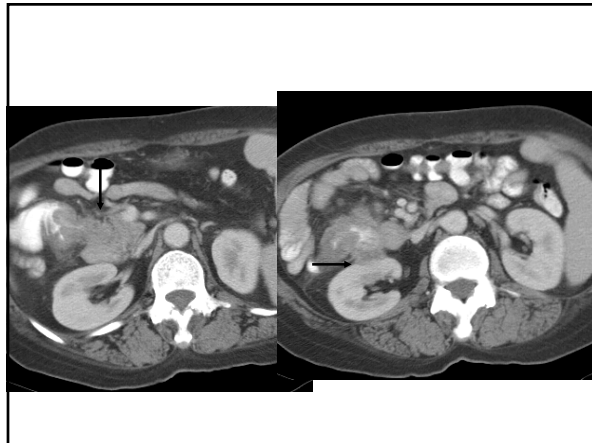
<http://virtualcolonoscopy.med.nyu.edu>  
**Michael Macari, M.D.**

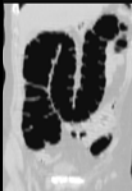

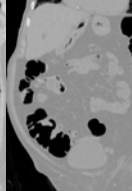
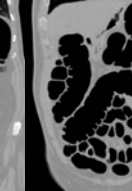
## Cancer Statistics

Site	New Cases	Deaths
Lung	174,470	162,460
Colon	147,000	55,170
Breast	214,640	41,430
Pancreas	33,730	32,300
Prostate	234,460	27,350

*CA Cancer J Clin 2006; 56:106-130*



## VC-The History

1 Slice	4 Slice	16 Slice	64 Slice
			
30 Seconds	30 Seconds	12 Seconds	6 Seconds

*Vining DJ, et al. Technical feasibility of colon imaging with helical CT and virtual reality (abstr). AJR 1994; 162:194.*

CA Cancer J Clin 2008;58:00-00

### Screening and Surveillance for the Early Detection of Colorectal Cancer and Adenomatous Polyps, 2008: A Joint Guideline from the American Cancer Society, the US Multi-Society Task Force on Colorectal Cancer, and the American College of Radiology<sup>††</sup>

Dr. B. Levin is Professor Emeritus, The University of Texas MD Anderson Cancer Center, Houston, TX.  
 Dr. Lieberman is Chief, Division of Gastroenterology, Oregon Health and Science University, Portland/Veterans Medical Center, Portland, OR.  
 Dr. McFarland is Adjunct Professor of Radiology, Washington University, St. Louis Hospital and Center for Diagnostic Imaging, Chesterfield, MO.  
 Dr. Smith is Director, Cancer Screening, Cancer Control Science Department, American Cancer Society, Atlanta, GA.  
 Dr. Brooks is Director, Prostate and Colorectal Cancer, Cancer Control Science Department, American Cancer Society, Atlanta, GA.  
 Ms. Andrews is Research Associate, Cancer Control Science Department, American Cancer Society, Atlanta, GA.  
 Dr. Dash is Executive Committee.

Benant Levin, MD; David A. Lieberman, MD; Beth McFarland, MD; Robert A. Smith, PhD; Danilo Brako, MD, MPH; Kimberly S. Anderson; Chintanjeev Dash, MD, MPH; Francis M. Giustadillo, MD; Seth Gluck, MD; Theodore R. Levin, MD; Perry Pickhardt, MD; Douglas K. Rex, MD; Alan Thornton, MD; Sidney J. Winawer, MD; for the American Cancer Society Colorectal Cancer Advisory Group, the US Multi-Society Task Force, and the American College of Radiology Colon Cancer Committee

### American College of Gastroenterology Guidelines for Colorectal Cancer Screening 2008

Douglas K. Rex, MD, FACP<sup>1</sup>, David A. Johnson, MD, FACP<sup>2</sup>, Joseph C. Anderson, MD<sup>3</sup>, Phillip S. Schoenfeld, MD, MSEd, MSc (Epi), Carol A. Burke, MD, FACP<sup>4</sup> and John M. Inadomi, MD, FACP<sup>5</sup>

This document is the first update of the American College of Gastroenterology (ACG) colorectal cancer (CRC) screening recommendations since 2000. The CRC screening tests are now grouped into cancer prevention tests and cancer detection tests. Colonoscopy every 10 years, beginning at age 50, remains the preferred CRC screening strategy. It is recognized that colonoscopy is not available in every clinical setting because of economic limitations. It is also realized that not all eligible persons are willing to undergo colonoscopy for screening purposes. In these cases, patients should be offered an alternative CRC prevention test (flexible sigmoidoscopy every 5–10 years, or a computed tomography (CT) colonography every 5 years) or a cancer detection test (fecal immunochemical test for blood, FIT).

Am J Gastroenterol 2009; 104:739–750; doi:10.1038/ajg.2009.104; published online 24 February 2009

## USPSTF/CMS Decision

- Issues
  - Data
  - Radiation
  - Extra-colonic Findings
  - Cost Effectiveness
  - Populations

## Data

## Meta-analysis of CTC\*

33 studies-data 6393 patients

- **Highly specific for polyps >9 mm**
- Sensitivity varies widely
  - < 6 mm 48%
  - 6-9 mm 70%
  - > 9 mm 85%

*\*Mullhall BP, et al Ann Intern Med 2005;142:635-650*

## Results of the Four Large Studies: Gastroenterologists Perspective?

Study	# of Patients	Sensitivity ≥ 10 mm polyps
Pickhardt 2003	1233	93%
<b>Johnson 2004</b>	<b>703</b>	<b>48%</b>
<b>Cotton 2004</b>	<b>615</b>	<b>55%</b>
<b>Rockey 2005</b>	<b>614</b>	<b>59%</b>

*Rex and Lieberman, Am J Gastroenterol 2006;101:1410-1413*



The NEW ENGLAND  
JOURNAL of MEDICINE

**Kim DH, Pickhardt PJ, et al. CT colonography vs  
colonoscopy for the detection of advanced neoplasia.  
NEJM 2007; 357:1403**



The NEW ENGLAND  
JOURNAL of MEDICINE

- CTC screening in 3120 consecutive adults
- OC screening in 3163 consecutive adults
- Detection of advanced neoplasia
  - The total number of polyps removed
  - Referral rate for polypectomy during VC was offered for all CTC-detected polyps of at least 6 mm in size
  - Patients with one or two small polyps (6 to 9 mm) were offered the option of CTC surveillance
  - During OC all detected polyps were removed



## The NEW ENGLAND JOURNAL of MEDICINE

- CTC 123 advanced neoplasms were found
  - 14 invasive cancers
- OC 121 advanced neoplasms were found
  - 4 invasive cancers
- Referral rate for OC in CTC screening group was 7.9% (246/3120)
- Advanced neoplasia was confirmed:
  - 100 of the 3120 patients in the CTC group (3.2%)
  - 107 of the 3163 patients in the OC group (3.4%)



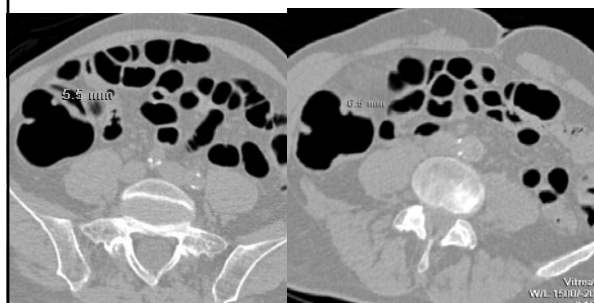
## The NEW ENGLAND JOURNAL of MEDICINE

- Total numbers of polyps removed:
  - CTC group 561
  - OC group was 2434
- 7 colonic perforations in the OC group
  - 4 requiring surgery
- 0 in the CTC group

### Shouldn't All Polyps Be Removed?

10/23/01

12/11/05



### Diminutive Lesions

- \*Waye et al, Am J Gastroent 1988;83:120  
1,048 polyps  $\leq$  6 mm- 61% Adenomas
- \*Lane et al, Gastroenterology 1971;60:537  
All polyps  $\leq$  3 mm-90% HP/NCM
- \*Aldridge et al, Eu J Surg 2001;167:777  
1,228 polyps  $\leq$  10 mm, 53% Adenomas, 0 cancer
- \*Nusco et al., Int J of Colorectal Surg 1997;12:267  
5,027  $\leq$  5 mm-No cancer in polyp  $\leq$  5 mm

### Epidemiology of Polyps in the Rectum and Colon\*

- 400 Patients 50-59 years
- 215 Polyps at endoscopy < 5 mm
- Two Year Follow-Up:
  - 50 % Hyperplastic Polyps
  - 23 % Mucosal Tags
  - 23 % Adenomas
- No Polyp was > 5 mm at Surveillance
- Regression Noted

\*Hoff G. Scan J Gastroenterol 1986; 21:853-862

### Cost-Effectiveness of Colorectal Cancer Screening With Computed Tomography Colonography

*The Impact of Not Reporting Diminutive Lesions*

Perry J. Pickhardt, MD<sup>1,2</sup>  
 Cesare Hassan, MD<sup>3</sup>  
 Andrea Laghi, MD<sup>4</sup>  
 Angelo Zullo<sup>5</sup>  
 David H. Kim, MD<sup>1</sup>  
 Sergio Morini, MD<sup>3</sup>

**BACKGROUND:** Prior cost-effectiveness models analyzing computed tomography colonography (CTC) screening have assumed that patients with diminutive lesions ( $\leq$ 5 mm) will be referred to optical colonoscopy (OC) for polypectomy. However, consensus guidelines for CTC recommend reporting only polyps measuring  $\geq$ 6 mm. The purpose of the current study was to assess the potential harms, benefits, and cost-effectiveness of CTC screening without the reporting of diminutive lesions compared with other screening strategies.

*Cancer 2007; 109:2213-2221*



The NEW ENGLAND  
JOURNAL of MEDICINE

Johnson CD, and others. Accuracy of CT colonography in the detection of large adenomas. NEJM 2008; 359:

### ACRIN Results

15 centers and 2531 asymptomatic patients over age 50

- Mechanical insufflation with CO2
  - stool and fluid tagging
- 90% sensitivity and **86% specificity** for adenomas 1 cm or larger
- 84% sensitivity in lesions  $\geq 7$  mm

### ACRIN Results

- 128 polyps one cm or larger were found in 109 patients 4.3% of the study
- Prevalence of lesions  $\geq 6$  mm was low at 8.3%
- Referral rate for OC will be low
  - (assuming low false positive rate)
- Seven cancers  $> 5$  mm were detected

### ACRIN Results

- Scanner or software did not influence outcomes
- 2D reads were as effective as primary 3D reads
  - Required six minutes less interpretation time
- Training important:
  - read 500 studies
  - undergo 1.5 days of training, including at least 50 cases
  - certifying exam, which required detection of 90% of abnormal lesions 1 cm or larger
  - half of readers did not initially pass and needed additional training

*Prospective Comparison of Colonoscopy,  
Sigmoidoscopy, CT Colonography, and Stool Tests in  
an Average Risk Population*

A. Graser, S. Geisbuesch, C. R. Becker, A. Lottes  
P. Stieber, C. Schaefer, H. Kramer, A. Wagner  
H. Diepolder, B. Goeke, M. F. Reiser, F. T. Kolligs

Departments of Clinical Radiology, Gastroenterology and Clinical  
Chemistry

University of Munich – Grosshadern Campus

### ACRIN Results

	$\geq 5$ mm	$\geq 6$ mm	$\geq 7$ mm	$\geq 8$ mm	$\geq 9$ mm	$\geq 10$ mm
Sensitivity	<b>65%</b>	<b>78%</b>	<b>84%</b>	<b>87%</b>	<b>90%</b>	<b>90%</b>
Specificity	<b>89%</b>	<b>88%</b>	<b>87%</b>	<b>87%</b>	<b>86%</b>	<b>86%</b>
PPV	<b>45%</b>	<b>40%</b>	<b>35%</b>	<b>31%</b>	<b>25%</b>	<b>23%</b>
NPV	<b>95%</b>	<b>98%</b>	<b>99%</b>	<b>99%</b>	<b>99%</b>	<b>99%</b>

**Gut** An International Journal of Gastroenterology & Hepatology

**COLONIC CANCER:**  
 A Graser, P Stieber, D Nagel, C Schäfer, D Horst, C R Becker, K Nikolaou, A Lottes, S Geisbüsch, H Kramer, A C Wagner, H Diepolder, J Schirra, H J Roth, D Seidel, B Göke, M F Reiser, and F T Kolligs

**Comparison of CT colonography, colonoscopy, sigmoidoscopy and faecal occult blood tests for the detection of advanced adenoma in an average risk population**

Gut, Feb 2009; 58: 241 – 248.

**307 Patients: Per polyp sensitivity: adenomas**

no. of adenomas n=221	Small ≤5 mm n=147	Medium 6-9 mm n=41	Large ≥10 mm n=33
<b>CTC</b>	<b>59.2%</b> [50.8–67.2%] (847/147)	<b>90.2%</b> [76.9–97.3%] (37/41)	<b>93.9% *</b> [79.8–99.3%] (31/33)
<b>OC</b>	<b>94.6%</b> [89.6–97.6%] (139/147)	<b>92.7%</b> [80.1–98.5%] (38/41)	<b>100.0% *</b> [81.7–>99.9%] (33/33)

## Flat Polyps

**JAMA**<sup>®</sup>  
 The Journal of the American Medical Association

HOME CURRENT ISSUE PAST ISSUES TOPIC COLLECTION

**CURRENT ISSUE:** Vol. 299, No. 9, March 5, 2008

**Prevalence of Nonpolypoid (Flat and Depressed) Colorectal Neoplasms in Asymptomatic and Symptomatic Adults**

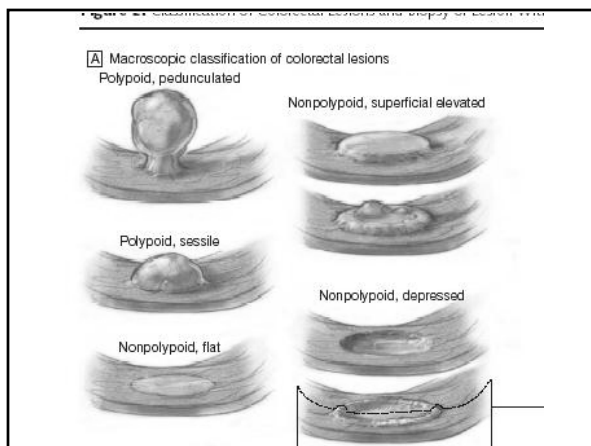
Ray M. Switzko, MD, MS  
 Tanya Killebrew, MD, MS  
 Robert V. Heise, MD  
 Walter Park, MD  
 Anamika Maheshwari, MD  
 Takara Sato, MD  
 Suzanne Matani, MD  
 Shai Krivdand, MD, MS

**Context:** Colorectal cancer is the second leading cause of cancer death in the United States. Prevention has focused on the detection and removal of polypoid neoplasms. Data are limited on the significance of nonpolypoid colorectal neoplasms (NP-CRN).

**Objectives:** To determine the prevalence of NP-CRN in a veterans hospital population and to characterize their association with colorectal cancer.

**Design, Setting, and Patients:** Cross-sectional study at a veterans hospital in California with 1019 patients undergoing elective colonoscopy from July 2003 to June 2004.

**Main Outcome Measures:** Endoscopic appearance, location, size, histology, and depth of invasion of neoplasms.

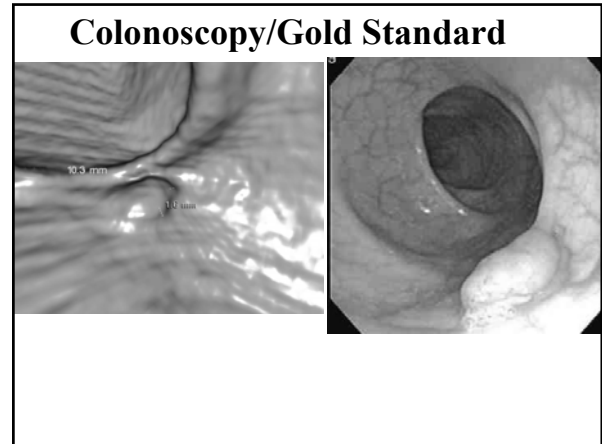
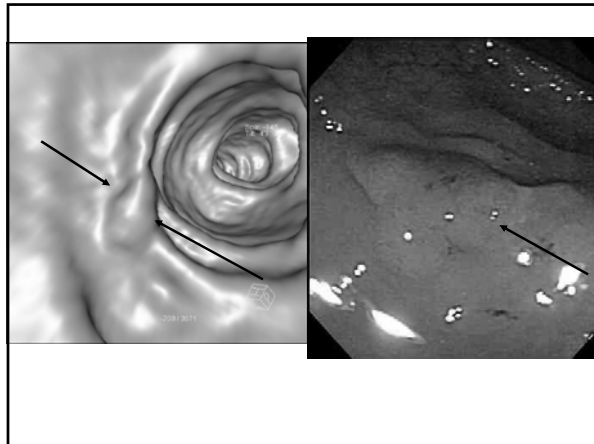


## Morphology

Mang T, et al. Detectability of Small and Flat Polyps in MDCT Colonography Using 2D and 3D Imaging Tools: Results from a Phantom Study. AJR 2005; 185:1582-1589.

MacCarty RL, et al. Occult Colorectal Polyps on CT Colonography: Implications for Surveillance. AJR 2006; 186: 1380-1383.

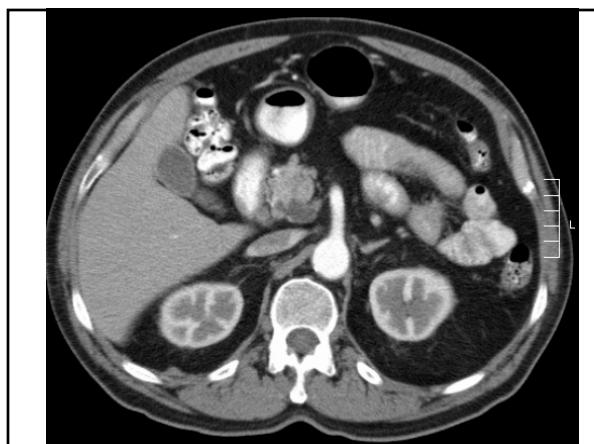
Park SH, et al. Flat Polyps of the Colon: Detection with 16-MDCT Colonography--Preliminary Results. AJR 2006; 186: 1611-1617



### Extra-colonic findings

- Important Issue
- Low Dose Scans
- Extra Costs for Work Up (\$25-30)\*
- But Important Findings Detected

*Rajapaksa RC, Macari M, Bini EJ. Prevalence and impact of extracolonic findings in patients undergoing CT colonography. J Clin Gastroenterol 2004; 38:767-771.*

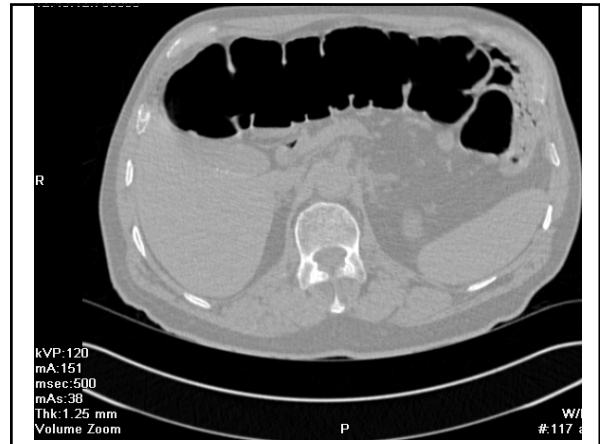


### Radiation Exposure

Examination	mSv
• Dental X rays	.005
• PA Chest	.01
• Abd X-ray	.6-1.7
• Mammogram	3 (breast)
• BE	3-8
• Nucs	2-10
• Background	3.6
• Chest CT	5-7
• <b>Abdominal CT</b>	<b>8-12</b>
• Neonatal Abdominal CT	25 (stomach)

## Radiation Exposure

Event	mSv
• Abdominal CT	8-12 mSv
• Flight NY-Seattle	.06
• Background	3/year
• XS dose to 4 million Ukraine/Chernobyl	13
• <b>A bomb survivor 2.3 km from Hiroshima</b>	<b>13</b>
• Radiation worker limit	20/year
• International Space Center	170/y

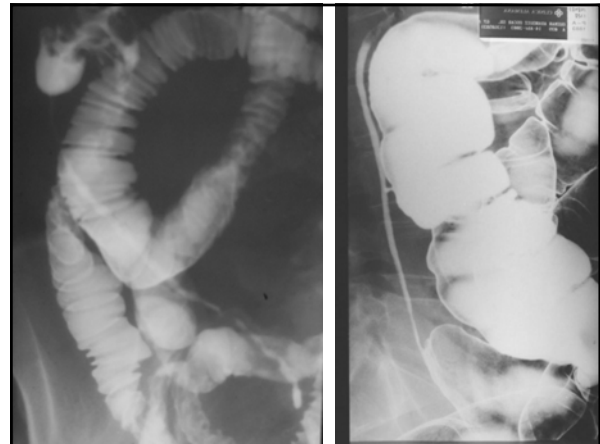
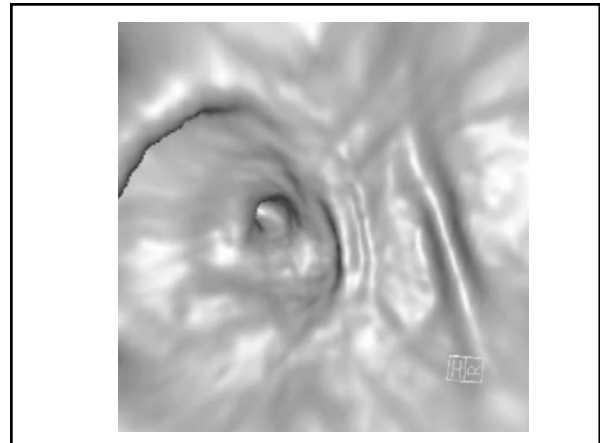


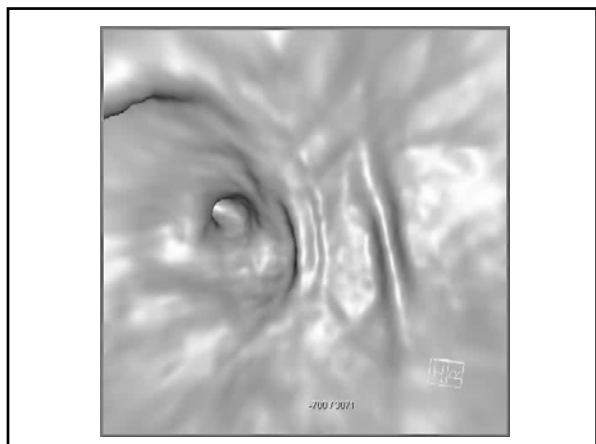
## Pancreas Protocol

Total mAs 9543		Total DLP 879					
Scan	KV	mAs / ref.	CTDIvol	DLP	TI	cSL	
Patient Position F-SP					5.3	1.0	
Topogram	1	120				100 ml 0.0 ml/s	
Contrast							
Panc Phase	2	120	170 / 230	13.26	321	0.5 0.8	
Venous	3	120	158 / 230	12.32	558	0.5 0.8	

## CTC Protocol

total mAs 1535		Total DLP 194					
Scan	KV	mAs / ref.	CTDIvol	DLP	TI	cSL	
Patient Position F-SP							
Topogram	1	120			5.3	0.6	
Colo_supine	2	120	30 / 50	2.30	100	0.5 0.6	
low Position F-PR							
Topogram	3	120			5.3	0.6	
Colo_prone	4	120	30 / 50	2.02	94	0.5 1.2	





## **Conclusions**

- CTC is not new
- Lots of research being performed
- Proper training/CTC technique/Dedication
- CTC can potentially impact
  - morbidity and mortality related to colon cancer