

# Adoption of CT Colonography by US Hospitals

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**Purpose:** Computed tomographic colonography (CTC) is a new noninvasive technology proposed as an option for colorectal cancer screening. The purpose of this study was to identify the percentage of US hospitals that offered CTC between 2005 and 2008 and factors that motivated or impeded adoption.

**Methods:** Data on the provision of colorectal cancer screening services by nonfederal, general hospitals were analyzed using the 2005 to 2008 American Hospital Association annual surveys. Additionally, in 2009, exploratory interviews were conducted with representatives from radiology departments at 9 hospitals; 6 that provided CTC and 3 that did not.

**Results:** In 2008, 17% of hospitals offered CTC, up from 13% in 2005. Sixty-nine percent of hospitals that offered CTC in 2008 also offered optical colonoscopy services. Factors motivating the adoption of CTC included a desire to provide an alternative screening option for frail, elderly patients and patients with failed optical colonoscopy; long waits for optical colonoscopy; and promising evidence on CTC published in peer-reviewed literature. Lack of reimbursement was a commonly cited barrier.

**Conclusions:** Growth of CT colonographic services at US hospitals occurred even in the absence of Medicare coverage or agreement among national guideline-setting organizations regarding CTC's use in screening. Almost one-third of hospitals that offer CTC do not offer optical colonoscopy and may not be prepared to provide adequate follow-up for patients with failed CTC.

**Key Words:** CT colonography, colorectal cancer, medical imaging, technology adoption

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## INTRODUCTION

Computed tomographic colonography (CTC), often referred to as virtual colonoscopy, is a promising new tool for colorectal cancer screening. CTC uses advanced visualization technology to produce 2-D and 3-D images of the colon and rectum, which allows a structural examination of the colorectum for the presence of polyps and other abnormalities. As with optical colonoscopy, the most common colorectal cancer screening test [1], patients must undergo colon cleansing before CTC. How-

ever, advantages of CTC over optical colonoscopy are that it is minimally invasive, allows visualization of the entire colorectum, is less time consuming, does not require sedation, and has a lower risk for perforation of the colon [2]. Limitations of CTC include the potential risk from repeated exposure to radiation and the inability to remove the polyps detected. Also, CTC commonly detects extracolonic findings, and the clinical, psychosocial, and cost implications of detecting and evaluating these findings remain unknown.

In 2008, two separate groups issued conflicting guidelines regarding CTC for colorectal cancer screening. In a first-of-its-kind joint guideline, the American Cancer Society, the ACR, and the US Multi-Society Task Force on Colorectal Cancer (a group that comprises representatives from the American College of Gastroenterology, American Gastroenterological Association, American Society for Gastrointestinal Endoscopy, and American College of Physicians) for the first time recommended CTC every 5 years as a cancer screening tool [3]. In contrast, the US Preventive Services Task Force con-

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cluded that evidence was insufficient to recommend CTC [4]. In 2009, CMS ruled that CTC would not be covered under Medicare for general screening, citing “insufficient evidence on the test characteristics and performance of screening CT colonography in Medicare-aged individuals” [5]. However, CTC is a covered benefit under Medicare and many private insurance plans if performed for very specific indications, such as for patients with failed optical colonoscopy.

Although CTC is not yet widely accepted as a colorectal cancer screening tool for average-risk adults, anecdotally, it is clear that many hospitals in the United States have adopted the service. As policymakers and others consider ways to increase colorectal cancer screening, it is important to understand US hospitals’ readiness to offer CTC and the factors that facilitate or impede adoption. Colorectal cancer is the second leading cause of cancer deaths in the United States [6]. Although reductions in mortality can be achieved through detection and treatment of early-stage colorectal cancers, only 50% to 60% of US adults aged  $\geq 50$  years are screened according to guidelines [7-9]. Some studies of patient acceptance, preference, and satisfaction suggest that many patients prefer CTC to optical colonoscopy [10], so it potentially represents an important option for increasing national screening rates.

However, the widespread use of CTC requires a coordinated system of care delivery. If an abnormality is identified through CTC, the patient may require optical colonoscopy for the removal of lesions. Ideally, radiologists and gastroenterologists work together to schedule the follow-up optical colonoscopy on the same day to avoid a second colon-cleansing preparation. Lack of coordination or availability of on-site optical colonoscopy services, though, may increase the number of people lost to follow-up after the initial CTC screen.

Although data have been collected on the capacity of providers to perform colorectal cancer screening using more established tools (fecal occult blood testing, sigmoidoscopy, and optical colonoscopy) [1,11,12], relatively little is known about CTC. The purpose of our study was to assess the extent to which US hospitals provide CTC, describe the availability of optical colonoscopy services at hospitals that offer CTC, and identify the factors that facilitate or impede hospitals’ implementation of CTC.

## METHODS

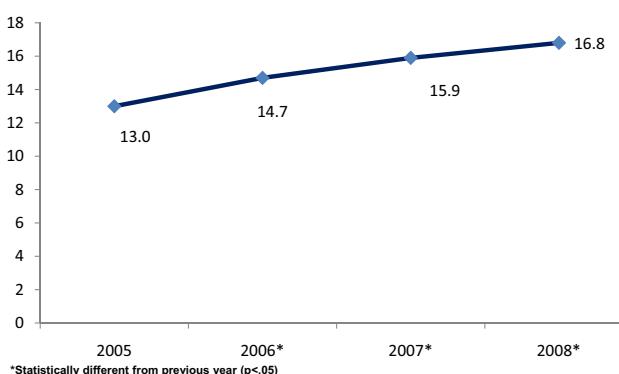
Data were obtained from the 2005 to 2008 American Hospital Association (AHA) annual surveys. The AHA annual survey is mailed to all hospital CEOs in the United States, who are instructed to circulate the survey to the individuals most appropriate to complete the differ-

ent sections of the survey. Response rates were 84% in 2005, 2006, and 2008 and 86% in 2007. The survey provides a cross-sectional view of the hospital industry, collecting information on hospital size, ownership, geographic location, services provided, and membership in the Council of Teaching Hospitals and Health Systems. The survey also collects information on revenue and expenses, which we used to calculate hospitals’ financial margin and then categorize hospitals into quartiles. We limited our analysis to nonfederal general hospitals that completed the survey. The number of completed surveys ranged from 3,895 to 4,021 between 2005 and 2008.

The AHA survey asks respondents to check a box if virtual colonoscopy (ie, CTC) is provided by the hospital or its subsidiary. Respondents are instructed to leave the box blank if the service is not provided. In 2008, a similar question pertaining to optical colonoscopy was added to the survey. We used descriptive statistics to identify the percentage of hospitals that offer CTC over time and across hospital characteristics. We used  $\chi^2$  tests to detect statistically significant differences between a subgroup of hospitals (eg, publicly owned hospitals) and all other hospitals.

Additionally, during September to November 2009, we conducted exploratory, key informant telephone interviews with radiologists or administrators from radiology departments at 9 hospitals; 6 that provide CTC and 3 that do not. Exploratory interviews are appropriate for describing issues in areas in which the literature is limited [13,14]. The small number of interviews reflects our desire to identify key issues surrounding the decision to adopt CTC yet not pose a burden on hospitals. We interviewed twice as many hospitals that offer CTC because we were also interested in exploring issues surrounding implementation of the technology. The 9 hospitals were a convenience sample drawn from the AHA survey and selected purposely so that our sample would include a diverse group of hospitals on the basis of bed size, teaching status, ownership, and geographic location.

Among respondents from hospitals that provide CTC, we asked about the motivation for providing the service, the number of CTC studies performed, reimbursement for services, and changes in staffing required to implement the service. For the remaining respondents, we asked whether they considered adopting the service and the factors that would influence the decision. We used an open-ended, semistructured interview protocol with prompts to draw out more specific information about certain factors that may have been considered in the decision to adopt CTC (eg, cost, reimbursement, staffing issues). Interviews were recorded and transcribed for analysis. Responses were separated by question and



**Fig 1.** Percentage of US nonfederal general hospitals providing CTC, 2005 to 2008.

grouped by hospital type (providing vs not providing CTC) to identify themes.

## RESULTS

### Percentage of US Hospitals Offering CTC

In 2008, 17% of all general, nonfederal hospitals in the United States offered CTC, up from 13% in 2005 (Fig. 1). There was a statistically significant increase in the percentage of hospitals providing the service each year.

Large hospitals, private nonprofit hospitals, hospitals located in the Northeast, nonrural hospitals, members of the Council of Teaching Hospitals and Health Systems, and hospitals that are affiliated with systems were more likely to offer the service than other hospitals (Table 1). There was no clear pattern by hospital financial status. Hospitals in the highest quartile for financial margins were less likely than other hospitals to provide the service; those in the second to highest quartile were most likely to offer the service.

Fifty percent of nonfederal general hospitals reported offering optical colonoscopy services in 2008. Among hospitals offering CTC in 2008, 69% also offered optical colonoscopy. Just under 12% of all hospitals offered both services.

### Factors Influencing the Adoption of CTC

When asked about the motivation for adopting CTC, respondents from the 6 hospitals that provide the service cited several reasons. Three said that they adopted the service to provide an alternative screening option for frail, elderly patients and patients with failed optical colonoscopy. Two said that there were long waits for optical colonoscopy, and CTC offered a way to meet patient demand for screening. One respondent said that low colorectal cancer screening rates in the community were a motivating factor.

All respondents said that there was at least one radiol-

ogist on staff who was enthusiastic about CTC on the basis of the promising evidence published in peer-reviewed literature. These individuals were proactive in getting the CTC programs implemented at the organizations. Four respondents reported that gastroenterologists on staff were also supportive of CTC because it provided an alternative for patients who could not undergo optical colonoscopy. However, two respondents reported an initial hesitation or lack of support for the service among gastroenterologists.

We also probed respondents about other factors that may have served as facilitators or barriers to the adoption of CTC. However, respondents generally said that these factors contributed little to the decision to adopt the service. For example, all had adopted CTC before 2008, so the new American Cancer Society screening guidelines were not a consideration. Costs were also not an issue. All of the hospitals had CT scanners with the capability to perform CTC. Half reported that they had to purchase carbon dioxide insufflators or software but considered these costs minor. Respondents said that competition with neighboring hospitals and patient demand for CTC were not motivating factors. In fact, some respondents were not aware whether other local hospitals offered CTC, and most said that patients and local primary care physicians were not familiar with CTC.

However, all respondents said that reimbursement was an important consideration. Respondents from 5 of the 6 hospitals providing CTC said that they provided  $<50$  CTC studies per year and that the service is primarily for patients with failed optical colonoscopy (ie, patients who are typically eligible for third-party reimbursement for CTC). The exception was a hospital that provided  $>1,000$  CTC studies per year. One of the radiologists on staff met with local insurers, provided data on CTC, and convinced them to cover the service for all covered patients. As a result, CTC is used for general screening in that community.

We also asked respondents for information on the startup of their CTC services. All said that it took  $<6$  months between the time the decision was made to offer CTC and its implementation. Radiologists received training on performing CTC readings, typically through a continuing education class that involved reviewing  $\geq 50$  cases. Technicians were also trained, though often in house. Two respondents reported hiring coordinators to manage their CTC programs. All respondents also said that optical colonoscopy services were available on-site, and same-day scheduling is typically available for CTC patients who require biopsies.

Respondents from the 3 hospitals that do not provide CTC all said that they had considered offering the service, but the lack of reimbursement for general screening and the cost of implementation were major barriers that

**Table 1.** Nonfederal, general hospitals providing CTC and optical colonoscopy, 2008

	Percentage of All Hospitals	Percentage Providing CTC	Percentage Providing CTC and Optical Colonoscopy
All hospitals	100 (n = 3,980)	16.8 (n = 669)	11.6 (n = 461)
Bed size			
Small (<100)	48	8.8*	5.2*
Medium (100-299)	34	17.7	12.1
Large ( $\geq 300$ )	18	36.5*	28.5*
Status			
Private not for profit	62	20.5*	14.6*
Private for profit	14	9.8*	6.3*
Public	25	11.6*	7.3*
Geographic location			
Midwest	31	17.4*	11.4
Northeast	12	27.1*	21.1*
South	38	13.8*	10.0*
West	18	15.0*	9.4*
Territories	0	17.7	11.8
Rural or nonrural			
Rural	47	10.8*	6.2*
Nonrural	53	22.2*	16.7*
COTH membership			
Yes	7	51.3*	44.8*
No	93	14.4*	9.4*
Affiliation			
Network hospital (ie, part of a hospital system)	38	20.4*	14.4*
Independent hospital	62	15.4*	10.6*
Financial margin			
Margin 1 (lowest financial margins)	25	14.5	9.5*
Margin 2	25	17.2	12.3
Margin 3	25	20.5*	14.6*
Margin 4 (highest financial margins)	25	14.8*	10.4

Source: Authors' calculations based on data from the 2008 American Hospital Association annual survey.

Note: COTH = Council of Teaching Hospitals and Health Systems, CTC = CT colonography.

\*Estimate is statistically different ( $P < .05$ ) from all other hospitals not in the indicated subgroup.

prevented them from proceeding with implementation. The estimated costs associated with the purchase of a carbon dioxide insufflator or software ranged from \$5,000 to \$20,000, according to respondents. Factors such as the availability of on-site gastrointestinal service, staffing needs, physical space, and local competition from hospitals offering the service were generally not major impediments to adopting CTC. One hospital, however, mentioned that the physical layout of the current facility limited their ability to provide patients with the necessary space to prepare for CTC.

## DISCUSSION

Conflicting recommendations from two national guideline setting bodies regarding CTC have spurred a debate over the role this relatively new technology should play in moving the nation toward higher colorectal cancer

screening rates. Although this debate continues, our study finds that the number of US hospitals providing CTC is modest but growing, from 13% in 2005 to 17% in 2008. Our findings are consistent with previous studies showing that imaging services are expanding [15,16]. However, the rapid growth of imaging services is often attributed to inaccuracies (ie, overpayment) in Medicare reimbursement for those services. Our study is unique in that we show expansion even in the absence of Medicare reimbursement for CTC for general screening.

Our results are also consistent with other studies finding that early adopters of new technologies tend to be major teaching hospitals, hospitals with higher patient volumes (ie, large hospitals) and hospitals located in states with higher average incomes (ie, hospitals in the Northeast) [17]. Past studies have shown that hospitals acquire new technology for many reasons, including the

desire to improve clinical care, competitive pressure from neighboring hospitals, profit seeking in an environment of favorable insurer reimbursement, and availability of capital to adopt new technologies [18]. Among the small number of hospitals we interviewed for the qualitative component of our study, the desire to improve clinical care, particularly for patients who cannot complete optical colonoscopy, and the enthusiasm of radiologists for CTC sparked by promising results of clinical trials were strong motivating factors. Because those hospitals already had CT scanners, the implementation of CTC required little additional capital.

Should a future goal be to expand the number of hospitals that offer CTC, our preliminary findings offer some good news. The individuals we interviewed reported a relatively quick and easy implementation of the service. Assuming that hospitals implementing the service already have suitable CT scanners, additional resource needs include appropriate software and a carbon dioxide insufflator. The cost of those purchases, although not negligible, represents a relatively small investment for a new service. Importantly, technologists and radiologists must receive appropriate training to prepare and position the patient and interpret the images, respectively [19].

A potential benefit of the growth of CTC is that frail, elderly patients and those who cannot complete optical colonoscopy have access to a suitable alternative for screening.

However, the availability of CTC at a local hospital does not necessarily indicate widespread access for the community. Although the qualitative component of our study was exploratory and results are not generalizable, our findings suggest that some hospitals focus their CTC programs on the subset of individuals who qualify for reimbursement (ie, patients with failed optical colonoscopy and patients whose private plans cover CTC). This is not necessarily surprising, especially considering that most hospitals with CTC also offer optical colonoscopy. It follows that these facilities would direct other patients to optical colonoscopy, which is typically a covered benefit, because the hospital and physician will be paid, and the patient has little out-of-pocket cost. Also, the relatively narrow focus of CTC programs on covered patients means that radiologists and gastroenterologists do not compete for patients. This might explain why gastroenterologists were generally in support of CTC adoption at the hospitals we interviewed.

It is concerning that >30% of hospitals that offer CTC do not also offer optical colonoscopy. These radiology departments would need to establish partnerships with other organizations that could accommodate same-day follow-up appointments for optical colonoscopy, to spare patients the need to undergo the rigorous colon

preparation required by both procedures a second time. Patients with abnormal findings on CTC might be reluctant to complete the recommended follow-up care if resource or scheduling constraints necessitate that they undergo a second colon preparation.

There were several limitations to this study. The AHA data simply indicate whether a hospital, including its affiliated outpatient centers, provides CTC services. There is no information currently available about the volume of procedures performed. Additionally, CTC may be performed by imaging or outpatient centers that are not affiliated with a hospital, and those organizations are not represented in this analysis. Also, we do not have information on who completed the AHA survey. It is possible that the individual completing the survey may not have known whether the organization provides CTC, particularly if the service was recently added. Additionally, our interviews were exploratory. We used a convenience sample and our results are not generalizable.

Despite these limitations, the study provides important baseline data on the availability of CTC among US hospitals. Radiologists are likely to continue to conduct research on CTC to address many of the concerns raised by CMS in the memo outlining its reimbursement decision (eg, concerns about radiation exposure, miss rates for small polyps, detection of incidental extracolonic findings, variability in performance) and to further advance the technology (eg, development of “prepless” CTC). Radiology groups, such as the ACR and the Radiological Society of North America, are well positioned to coordinate the collection of data from hospitals, outpatient centers, and imaging centers to track, monitor, and report CTC utilization. These data would be beneficial to public health researchers and policymakers as they consider strategies for increasing colorectal cancer screening rates and the role that CTC should play.

Widespread implementation of CTC, though, and its expansion to a broader group of patients, may be difficult under current reimbursement policies. The impact of Medicare’s recent decision on future adoption of CTC is uncertain. Although more information related to procedure outcomes is needed, CTC’s relatively easy implementation coupled with improved patient acceptance makes CTC a tool that holds promise for the future of colorectal cancer prevention.

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