# Is There Sufficient MDCT Capacity to Provide Colorectal Cancer Screening with CT Colonography for the U.S. Population?

Perry J. Pickhardt[1,2]
Cesare Hassan[3]
Andrea Laghi[4]
David H. Kim[1]
Angelo Zullo[3]
Franco Iafrate[4]
Sergio Morini[3]

**OBJECTIVE.** The impact of introducing widespread colorectal cancer (CRC) screening with CT colonography (CTC) on current resource capacity is unknown. Although a relatively large number of MDCT scanners are currently in operation throughout the United States, these existing units already perform studies for a wide array of indications. Our aim was to assess the ability of the available MDCT capacity in the United States to provide population screening with CTC.

**MATERIALS AND METHODS.** Mathematic and Markov models were used to assess the mean number of CTC procedures per MDCT scanner per day (expressed as CTC/MDCT/day) necessary for both the startup and steady-state phases of a nationwide screening effort. Plausible ranges were applied to a number of variables in the sensitivity analysis. The number of existing CT scanners in the United States was based on 2006 estimates.

**RESULTS.** At baseline analysis, assuming gradual increases in compliance, CTC penetrance (percentage of screening-compliant population who would opt for CTC), and MDCT capacity, a total of 37,227,541 adults would need to undergo CTC screening over a 10-year startup period, corresponding to 1.2–1.6 CTC/MDCT/day. Assuming a 5-year routine screening interval between the ages of 50 and 80 years, the number of CTC studies needed to be performed in the steady-state period is 1.2 CTC/MDCT/day. These estimates were sensitive to variations in compliance, MDCT capacity, population size, interval for the startup phase, and the routine CTC screening interval.

**CONCLUSION.** CT capacity in the United States appears to be adequate for handling the potential demand related to mass population screening with CTC, even without assuming a specific CTC-driven increase in MDCT supply.

**Keywords:** CT, CT colonography, MDCT, screening, virtual colonoscopy

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P. J. Pickhardt is a consultant for Viatronix, Inc., C. B. Fleet Company, and Medicsight. D. H. Kim is on the medical advisory board of C. B. Fleet Company and receives lecture honoraria from Viatronix, Inc.

[1]Department of Radiology, University of Wisconsin Medical School, E3/311 Clinical Science Center, 600 Highland Ave., Madison, WI 53792-3252. Address correspondence to P. J. Pickhardt.

[2]Department of Radiology, Uniformed Services University of the Health Sciences, Bethesda, MD.

[3]Gastroenterology and Digestive Endoscopy Unit, "Nuovo Regina Margherita" Hospital, Rome, Italy.

[4]Department of Radiological Sciences, University of Rome La Sapienza "Policlinico Umberto I," Rome, Italy.

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Colorectal cancer (CRC) remains a major cause of mortality in the United States, accounting for more than 50,000 deaths each year [1]. Although prevention of CRC through population screening is highly effective, compliance is disturbingly low. Compared with compliance rates of 70–75% or more for breast, cervical, and prostate cancer screening, participation in CRC screening has been reported to be less than 50% [2]. An even smaller percentage of the screening population, less than 20%, has undergone the generally preferred total colonic examination with optical colonoscopy (or barium enema examination) [3]. However, even if compliance rates for colonoscopic screening were significantly higher, a number of studies have shown an inadequate endoscopic capacity to meet this potential demand [3–7].

CT colonography (CTC), also referred to as "virtual colonoscopy," represents an emerging full structural screening examination that has shown great promise for CRC screening, with an ability to detect relevant benign and malignant lesions that is comparable to optical colonoscopy [8–10]. One potential advantage of CTC over colonoscopy is its less-invasive nature, which could translate into improved compliance and draw more adults off of the screening "sidelines" [11]. Although one previous study has addressed the potential impact of widespread CTC screening on colonoscopy volumes [6], we are not aware of any systematic analysis evaluating the current capacity of CT itself for providing mass screening. Such analysis will be critical if third-party reimbursement for CTC screening is imminent. Because existing MDCT scanners already perform a wide variety of clinical imaging examinations, only a fraction of operational time would likely be devoted to CTC screening, at least in the initial phase of implementation.

The aim of this simulation analysis was to compare the potential demand for reimbursed CTC screening with the current MDCT capacity in the United States for both the startup and steady-state phases of a nationwide CRC screening effort.

## Materials and Methods

When considering average-risk population screening for CRC, two distinct demands on the available health care resources should be clearly distinguished: a startup period during which the unscreened individuals 50–75 years old in the population will undertake their first screening examination and a steady-state period during which only those adults turning 50 years old require their initial testing, whereas the remaining group undergoes periodic retesting until reaching 80 years old. For the purposes of this work, CTC represents the specific CRC screening test under consideration, with a routine 5-year follow-up interval used in the baseline analysis.

To address the first issue regarding the startup phase, we constructed a simple mathematic model for predicting CTC demand by simulating progressive uptake of CTC on the compliant population. The primary measured outcome was the total number of CTC examinations needed per year, assuming a 10-year span as a realistic time frame for catching up with all the millions of unscreened 50- to 75-year-old individuals in the United States. Because we assumed the routine screening interval for CTC would initially be set at 5 years [8, 12, 13], repeat screenings in the second half of the 10-year startup period were added to the new screenings in the startup phase.

To deal with the second issue of steady-state demand, we used a previously validated Markov model to estimate the total number of CTC examinations needed to be performed each year once the screening program reaches this steady state [14]. The CTC totals from the two phases were then divided among all operational MDCT units available in the United States for the standard number of working days per year to establish the number of CTC procedures per day that each MDCT unit should perform to meet the simulated demand (expressed as CTC/MDCT/day). Of course, this average workload does not imply an even distribution of utilization among MDCT scanners. A broad range of usage would be expected, with some scanners performing a relatively large volume of CTC studies and others not performing any.

### *Model Inputs*

The baseline values for the main parameters used in the startup and steady-state phase models, and the ranges applied for the sensitivity analysis, are reported in Table 1. For this study, we assumed that nonhelical and single-detector helical CT scanners were incapable of performing technically adequate CTC examinations. Therefore, only MDCT scanner capacity was considered in the analysis.

### *Population*

Over the course of the 10-year startup period, all 40- to 50-year-old individuals in the population will turn 50 years old and be eligible for average-risk CRC screening. For this reason, the initial population consisted of the entire average-risk 40- to 75-year-old population available from U.S. census data [15]. This population figure was adjusted to account for mortality from all causes and was further reduced by those considered to be too frail to undergo colonoscopy [16]. As with prior studies evaluating endoscopic capacity, we focused on average-risk adults, excluding from primary consideration those with inflammatory bowel disease or a positive family history of CRC.

In an attempt to more closely simulate real-world experience, we did not choose a fixed value for screening compliance or CTC penetrance. Instead, we assumed that CTC implementation and patient acceptance for a noninvasive screening option would result in a gradual increase in the overall CTC compliance rate during the 10-year startup period. For this reason, overall CRC screening compliance (by any means) was assumed to grow in a linear fashion from 40% in year 1 to 60% at the end of the 10-year startup period. These values are lower than the 75% compliance achieved by breast or prostate screening but significantly higher than compliance with optical colonoscopy screening [3]. Although CTC is relatively noninvasive, it requires a bowel preparation and carries the potential for some degree of social embarrassment, which will likely limit compliance somewhat. Therefore, it is highly unlikely that the entire U.S. screening population will suddenly regard CTC as the only acceptable screening strategy. To address this issue, we assumed that only a certain fraction of the compliant screening population will favor CTC over other available screening options, which progressively increased from an initial penetration of 10% in year 1 to 67% in year 10 of the startup phase. Put another way, CTC penetrance was defined as the percentage of the screening-compliant population who would opt for CTC. Combining the different values on compliance and CTC penetrance for each year provided the final numbers of adults in need of CTC screening.

### *Markov Model*

To evaluate the number of CTC examinations performed in the steady-state phase of population screening, we used a Markov model on a hypothetical cohort of 100,000 average-risk subjects ranging from 50 to 100 years old, as previously modeled in articles focusing on colonoscopic screening capacity [4, 5]. Details of this Markov model are reported elsewhere [14]. Briefly, the natural history of colorectal neoplasia was calibrated to reproduce the age- and sex-specific

**TABLE 1: Characteristics and Parameters Used in the Two Mathematic Models for CT Colonography (CTC)**

| Variable | Reference Case Value (Range) |
|---|---|
| Population | |
| U.S. adults 40–75 years old | 102,785,485 [15] |
| All-cause mortality per year (%) | 1.25 [16] |
| Too frail for colonoscopy (%) | 5 [6, 27] |
| Population at increased colorectal cancer risk (%) | 6.7 [3] |
| Overall screening compliance (%) | 40–60[a] (10–90) |
| CTC penetrance (%)[b] | 10–67[a] (10–90) [6] |
| Compliance to repeat CTC (%) | 50 (25–75) [17, 18] |
| Duration of startup period (y) | 10 |
| Routine CTC screening interval (y) | 5 (5–10) [12, 13] |
| CT capacity | |
| Total CT units in United States | 10,100–13,620a (± 50%) [19] |
| MDCT units from total (%) | 71–85[a] (± 50) [19] |
| MDCT units performing CTC (%) | 10–90[a] (± 50) [19] |

Note— The range shown for each variable in parentheses represents the interval used for the sensitivity analysis.
[a]Assumed to gradually increase in a linear fashion from the first to the 10th year of the startup period. When applicable, the ending values for the startup phase were chosen for the steady-state simulation.
[b]Defined as the percentage of compliant adults who opt for CTC over other available screening options.

adenoma prevalence at autopsy and screening studies as well as the incidence and mortality rate of CRC [14]. The health intervention superimposed on the natural history model was CTC repeated every 5 years between 50 and 80 years old (inclusive). For this analysis, we assumed that those found to have an adenoma > 5 mm required endoscopic follow-up, which prevented further CTC screening. All others were eligible for repeat screening CTC in 5 years. Although all endoscopic and radiologic CRC screening tests are advised to be repeated every 5 or 10 years, compliance for repeated examinations over a lifetime period is largely unknown. Although some postpolypectomy trials have shown short-term compliance for repeated colonoscopy of 80% [17, 18], we thought that a 50% compliance for 5-year CTC repetition over a lifetime to be a more realistic baseline assumption.

To project the outcomes of our simulation on the entire U.S. population, we assumed a steady state for population size and age distribution, represented by the 2000 census data [15]. Each age-specific output (per person) of the model was multiplied by the total number of people that age in the U.S. population. Adding the results for all ages yielded national estimates on the number of CTC examinations needed to be performed each year.

### *CT Capacity*

The IMV Medical Information Division [19] periodically conducts surveys involving sites that perform CT examinations in the United States. In the most recent census, performed between February and August 2006, 2,565 of an estimated total of 7,649 sites provided information regarding the number and category of CT procedures and the characteristics of CT scanners. As noted, we only considered MDCT scanners as capable of performing technically adequate CTC examinations. Briefly, according to this survey, 10% of all the centers performed CTC examinations, yielding an estimated capacity of 200,000 procedures per year in 2006. Assuming third-party reimbursement for screening CTC, balanced by the need for appropriate training and investment in CTC-specific equipment (i.e., CTC software and carbon dioxide insufflator), we estimated that this rate would only gradually rise to 90% by the end of the 10-year startup period. Furthermore, we simulated a progressive annual increase of 3.5% in the total number of CT scanners over the 10-year period and an increase of the relative percentage of MDCT scanners from the current 71% to 85% by year 10. Of note, we did not assume that the advent of widely reimbursed CTC itself would impact MDCT supply in the baseline analysis, but we did simulate the possibility of further increases in capacity in the sensitivity analysis.

The number of regular working days for MDCT operation was assumed to be 250. For the sensitivity analysis, the number of operational days was increased to 350 to reflect the possibility that weekend CTC examinations may be an attractive option for working adults.

### *Sensitivity Analysis*

One-way and two-way sensitivity analyses were performed for all the variables of the model (Table 1), with selective reporting of results considered to be most relevant.

**TABLE 2: Potential CT Colonography (CTC) Demand and MDCT Capacity During Startup Period**

| Year | Overall Compliance (%) | CTC Penetrance (%) | No. To Be Screened with CTC | Total CT Units | MDCT Fraction (%) | MDCT Units Performing CTC (%) | CTC Exams per MDCT Unit per Day |
|---|---|---|---|---|---|---|---|
| 1 | 40 | 10 | 295,750 | 10,110 | 71 | 718 (10) | 1.6 |
| 2 | 42 | 16 | 506,664 | 10,500 | 73 | 1,437 (19) | 1.4 |
| 3 | 45 | 22 | 738,665 | 10,890 | 74 | 2,237 (28) | 1.3 |
| 4 | 47 | 29 | 991,754 | 11,280 | 76 | 3,120 (37) | 1.3 |
| 5 | 49 | 35 | 1,265,929 | 11,670 | 77 | 4,090 (46) | 1.2 |
| 6 | 52 | 41 | 1,709,066 | 12,060 | 79 | 5,150 (54) | 1.3 |
| 7 | 54 | 47 | 2,130,872 | 12,450 | 80 | 6,303 (63) | 1.4 |
| 8 | 56 | 53 | 2,584,309 | 12,840 | 82 | 7,551 (72) | 1.4 |
| 9 | 58 | 60 | 3,069,376 | 13,230 | 83 | 8,899 (81) | 1.4 |
| 10 | 60 | 67 | 3,586,073 | 13,620 | 85 | 10,349 (90) | 1.4 |

Note—Overall compliance indicates total participation in screening, by any technique. CTC penetrance indicates the percentage of compliant adults who favor CTC over other available screening options. MDCT fraction indicates the percentage of all CT scanners that are multidetector and therefore CTC capable. MDCT units performing CTC indicates the number (and fraction) of MDCT scanners actually performing CTC.

### *Validation*

To validate our models, we computed the main outcome (number of CTC examinations needed per year) assuming the parameters chosen in other studies dealing with a related topic: the impact of CTC on endoscopic volumes. Regarding the startup period, simulating 55% compliance and 67% CTC penetrance, our model computed the need for 4.73 million CTC examinations per year, which is quite similar to the 4.85 million estimated by Hur et al. [6] with the same assumptions. Regarding the steady-state period, when simulating CTC screening with a 10-year interval at a simulated compliance of 75%, the predicted number of CTC examinations per year was estimated at 6.2 million by our model, equal to the estimate reported by Ladabaum and Song [4] using the same assumptions.

## Results

### *Startup Phase*

At the simulated compliance and eligibility rate, 37,227,541 U.S. adults would need to be screened for CRC in the 10-year startup phase. As shown in Table 2, assuming a progressive increase of CTC penetrance, the median number of CTC examinations to be performed each year was 1,487,497, ranging from 295,750 in year 1 to 3,586,073 in year 10. The higher number of CTC examinations after the fifth year is due not only to the simulated increases in compliance and CTC penetrance but also to the need for repeat screening in compliant adults related to the 5-year CTC interval.

The total number of operational CT units in the United States was assumed to increase from 10,100 to 13,620 by the end of the 10-year startup period (Table 2). Similarly, the relative percentage of MDCT scanners was simulated to increase from 71% to 85%, corresponding to 7,171 and 11,509, respectively. The percentage of MDCT scanners performing CTC rose from a low of 10% to 90%. Consequently, the number of MDCT units available for performing CTC during the startup period ranged from an initial 718 to an ending value of 10,349 (median, 4,620). Assuming each available MDCT unit performed one CTC examination per day, multiplying this value by the number of standard working days per year provides the annual number of CTC examinations, which ranges from 179,453 to 2,587,201. Assuming two CTC/MDCT/day yields from 358,905 to 5,174,401 total studies, and three CTC/MDCT/day yields from 538,357 to 7,761,602 studies. The lower and upper limits of these ranges represent the number of CTC procedures during the first and tenth years of the startup period, respectively.

Dividing the number of people who need to be screened by CTC by the number of available MDCT units provides the number of CTC examinations to be performed each year by each MDCT scanner. At baseline, this value equals 412 CTC procedures per MDCT scanner in the first year and 346 CTC procedures per scanner in the last year, with a median of 340, corresponding to 1.4 CTC studies per MDCT unit per working day (range, 1.2–1.6 studies).

At sensitivity analysis, compliance to initial screening, CTC penetrance, MDCT capacity, the duration of the program, and the population size appeared to be key variables. As shown in Figure 1, a reduction in compliance from 60% at 10 years to 30% decreased the number of CTC/MDCT/day from 1.4 to 0.7, whereas an increase in compliance to 90% resulted in the need for two CTC/MDCT/day. Similarly, a drop in CT penetrance at 10 years from 66% to 33% reduced the number of daily CTC studies per MDCT unit to 0.7, whereas an increase to 85% led to 1.8 examinations per day. At two-way sensitivity analysis, assuming a CTC penetrance of 85% (30% compared with baseline), a compliance variation from 60% to 67% was enough to increase the CTC/MDCT/day to two, whereas fixing CTC penetrance at 46% (–30% compared with baseline), even with compliance as high as 90%, kept the number of CTC/MDCT/day at 1.4 (Fig. 1).

Regarding MDCT capacity, a 50% decrease in the units available for CTC throughout the 10-year period would increase the number of examinations per scanner from 1.4 to 2.7 per day, whereas a 50% increase in MDCT capacity would reduce such need to 0.9 CTC/MDCT/day. Two-way sensitivity analysis for compliance and MDCT capacity is shown in Figure 2. Once a 50% increase in MDCT capacity is simulated, even broad variations of initial compliance were unable to substantially increase the number of CTC/MDCT/day beyond 1.4.

Reducing the duration of the startup period from 10 to 5 years without any variation in the other variables increased the baseline of CTC/MDCT/day from 1.4 to 2.2 (range, 2.0–2.8 units). The overall number of people to screen in this phase was reduced to 27,576,814. Increasing the number of operational days to include regular weekend days reduced the CTC/MDCT/day to one. Limiting the screening population to those younger than 65, 60, or 55 years would reduce the burden of CTC examinations from the baseline of 1.4 to 1.1, 1.0, and 0.8 CTC/MDCT/day, respectively.

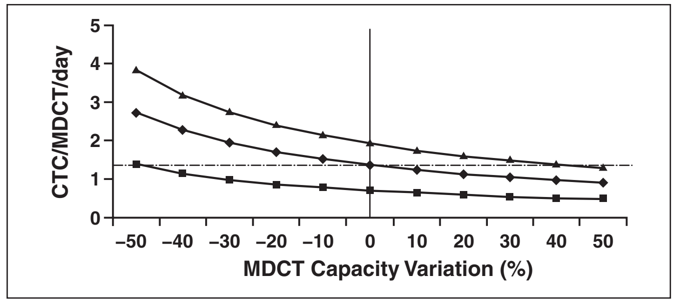


**Fig. 1**—Graph of sensitivity analysis (startup period) shows variation of mean number of CT colonography (CTC) examinations needed to be performed by each MDCT unit per day to screen U.S. population according to overall screening compliance and specific CTC penetrance. Solid vertical line indicates baseline. Dashed line indicates number of CTC/MDCT/day at baseline assumptions. Baseline penetrance = ◆, 30% penetrance = ■, –30% penetrance = ▲.

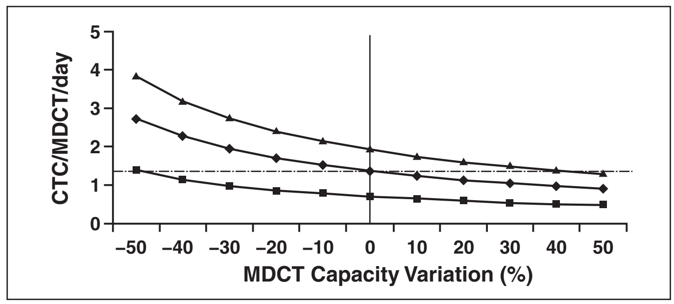


**Fig. 2**—Graph of sensitivity analysis (startup period) shows variation of mean number of CT colonography (CTC) examinations needed to be performed by each MDCT unit per day to screen U.S. population according to MDCT capacity and overall screening compliance. Solid vertical line indicates baseline. Dashed line indicates number of CTC/MDCT/day at baseline assumptions. Baseline compliance = ▲, 30% compliance = ■, 85% compliance = ◆.

### *Steady-State Phase*

Screening in the steady-state was simulated with 5-year repetition of CTC between the ages of 50 and 80 years. Initial compliance and penetrance were set at 60% and 67%, corresponding to the values reached in the final year of the startup period. Compliance for repeated CTC thereafter was set at 50%. The overall number of CTC procedures needed to be performed per year in the steady-state period for the average-risk U.S. population was 3,064,151. Dividing this value by the estimated MDCT capacity at the end of the startup period corresponds to 296 CTC procedures per MDCT per year and 1.2 CTC/MDCT/day.

At sensitivity analysis, the potential CTC demand was volatile to variation in initial and repeated compliance as well as MDCT capacity. As shown in Figure 3, a decrease in initial compliance from 60% to 30% was sufficient to reduce the number of CTC/MDCT/day to 0.6. On the other hand, even large increases in compliance failed to increase the CTC/MDCT/day to more than two. Our analysis was also sensitive to compliance for repeated CTC examination. A drop from 50% to 25% reduced the need to 0.8 CTC/MDCT/day, whereas an increase in repeat compliance to 75% increased the demand to 1.5 CTC/MDCT/day (Fig. 3). Similarly, increasing the routine screening interval from 5 years to 10 years reduced the demand to 0.8 CTC/MDCT/day. As shown in Figure 4, an increase in MDCT capacity by 50% would prevent any variation of compliance to substantially increase CTC demand, whereas a 50% decrease in MDCT capacity would impose strenuous pressure on the available centers with 2.4 CTC/MDCT/day.

Limiting the screening population to those younger than 65, 60, or 55 years old would decrease the number of CTC/MDCT units/day from the baseline of 1.2 to 0.8, 0.7, and 0.5, respectively.

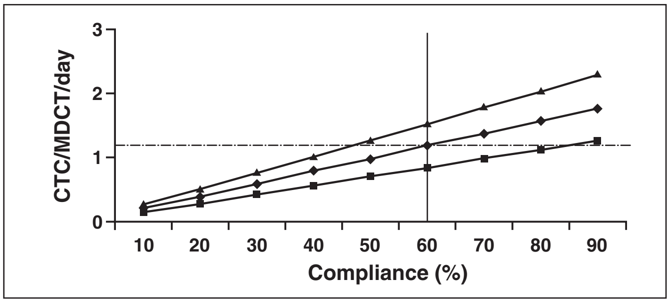


**Fig. 3**—Graph of sensitivity analysis (steady-state period) shows variation of mean number of CT colonography (CTC) examinations needed to be performed by each MDCT unit per day to screen U.S. population according to initial overall screening compliance and specific compliance to 5-year repeated CTC examination. Solid vertical line indicates baseline. Dashed line indicates number of CTC/MDCT/day at baseline assumptions. Baseline repeating compliance = ◆, 25% repeating compliance = ■, 75% repeating compliance = ▲.

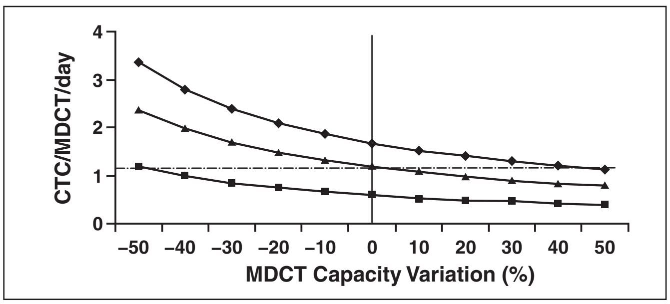


**Fig. 4**—Graph of sensitivity analysis (steady-state period) shows variation of mean number of CT colonography (CTC) examinations needed to be performed by each MDCT unit per day to screen U.S. population according to MDCT capacity and overall screening compliance. Solid vertical line indicates baseline. Dashed line indicates number of CTC/MDCT/day at baseline assumptions. Baseline compliance = ▲, 30% compliance = ■, 85% compliance = ◆.

## Discussion

It has been estimated that nearly 2 million screening colonoscopies are performed each year in the United States [5, 6], involving approximately 6,000 practice sites [20]. It has also been shown that the endoscopic capacity is insufficient to provide a singular solution for effective nationwide screening in either the startup or steady-state phases [3, 5, 7], which suggests the need for either a substantial increase in endoscopic capacity or additional effective options for CRC screening and prevention. CTC represents a promising addition to the national screening armamentarium, providing for effective total colonic examination in a safe and cost-effective manner [8, 10, 14, 21–23].

MDCT, the logistical backbone for performing CTC, is widely available in the United States, and because of the many clinical indications for MDCT imaging, continued increases in capacity are expected regardless of the ultimate demand for CTC. The fact that only about 10% of scanners are currently performing CTC simply reflects the current lack of third-party reimbursement for screening examinations. However, the actual rate and ultimate level of increased utilization once widespread third-party coverage is in place will depend on a variety of factors that may influence the interest of radiologists. Such factors include the level of reimbursement, the time required for interpretation, and the need for specific training and possibly even site accreditation. Moreover, there will undoubtedly be an uneven distribution in MDCT utilization for CTC, with dedicated high-volume screening centers probably performing the bulk of the examinations.

Beyond the MDCT scanner, the capital investment required for providing CTC screening is relatively minimal [24]. Our analysis shows that even with conservative input assumptions, MDCT capacity in the United States should be adequate for handling the increased demand related to population screening with CTC, even without assuming any specific CTC-driven increase in MDCT supply. For both the startup and steady-state phases of widespread CTC screening, the average number of studies per scanner per day was generally less than two for a broad range of input assumptions.

The sensitivity analysis did show that MDCT capacity itself was a critical variable in our model. For instance, a 50% increase in capacity over the baseline value was highly protective against much higher increases in patient compliance or CTC penetration, resulting in less than one CTC study per scanner per day on average. There are reasons to believe that our baseline input values for MDCT capacity would grossly underestimate actual capacity if widespread CTC screening took hold. For one, we did not assume that the emergence of mass screening with CTC itself would have any impact on MDCT capacity. However, one might reasonably argue that widespread reimbursement for CTC screening would help drive an increase in the overall number of MDCT scanners in operation.

In addition, these additional scanners might allow MDCT units that are more dedicated to CTC, which would further decrease the overall burden on the typical multipurpose scanners. Some CTC-specific MDCT units have already been installed in centers that are more immune to third-party reimbursement issues (e.g., the National Naval Medical Center in Bethesda, MD). Moreover, according to the IMV report [19], 33% of the U.S.-based CT sites operate for less than 9 hours per day and an additional 51% operate less than 13 hours per day, offering the possibility for substantially increased CTC capacity without investment in new equipment [19]. Routine CTC screening over the weekend could also increase MDCT capacity considerably.

The baseline assumption for CTC penetration of the compliant population rose to as high as 67% in our model, which assumes that CTC would ultimately be the most favored screening option. Any reduction in penetrance, such as a strong continued presence of primary optical colonoscopy screening, would reduce the CTC burden even further. Synergistic approaches to parallel CTC and colonoscopy screening programs could potentially lead to more efficient and optimal use of existing capacities. For example, endoscopy sites could dedicate their finite resources to cases that are more likely to be therapeutic, perhaps reserving average-risk screening to the less-invasive and less-costly CTC procedure.

Our baseline analysis shows that a routine CTC follow-up interval of 5 years in the steady state would result in the need for only about one study per MDCT scanner per day on average. This assumes an initial screening compliance of 60% and compliance to repeat screening of 50%. In comparison, less than 20% of the average-risk population has been screened by optical colonoscopy. Such suboptimal compliance rates applied to CTC or an increase in the CTC screening interval to 10 years would significantly decrease the number of CTC examinations performed.

To our knowledge, this is the first study to formally assess the feasibility of widespread CTC screening in terms of operational MDCT units. One limitation of this study was that we did not address the supply of radiologists. Although a shortage of radiologists existed in the United States in 2000 [25], the situation has apparently eased considerably in subsequent years [26]. An additional limitation was the simulated nature of the study, which is, of course, unavoidable when projecting future developments. Furthermore, we did not consider geographical differences, such as urban versus rural practice. However, even across broad variations in the input parameters, our study shows that the available MDCT capacity in the United States is large enough to satisfy the potential demand of population screening with primary CTC evaluation, for both the startup and steady-state periods. The potential for further increases in MDCT capacity as a direct result of widespread implementation of CTC screening itself provides an even more optimistic outlook for this technique.

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