The Impact of Improved Colorectal Cancer Screening Rates on Adequacy of Future Supply of Gastroenterologists

Final Report

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I. Executive Summary

The nation's ability to provide timely, high quality colorectal cancer (CRC) screening requires an adequate supply of clinicians with formal training to provide such services. While family physicians, general internists, surgeons, and (recently) radiologists provide some CRC screening services, gastroenterologists provide the majority of colonoscopies—the gold standard for CRC prevention. The purpose of this study is to assess the future adequacy of gastroenterologist supply to help ensure the nation's ability to provide colonoscopy services.

Using two simulation models—the *National Colorectal Screening Model* and the *Physician Supply and Demand Model*—we provide evidence-based extrapolations of the impact of changes in CRC screening rates, trends in screening modality, and other trends in gastroenterologist supply and demand determinants on the future adequacy of gastroenterologist supply.

A shortfall of approximately 1,050 gastroenterologists (8%) is projected by 2020 under a baseline scenario where health care use and delivery patterns remain unchanged, and where gastroenterologist supply determinants (number of fellows trained, retirement rates, hours worked patterns) remained unchanged.

- The supply of gastroenterologists active in patient care is estimated to be 10,390 in 2008 (including both adult and pediatric gastroenterologists).
- Supply is projected to grow by 1,070 (10%) full time equivalents (FTEs) between 2008 and 2020 to 11,460 FTEs.
- Under the assumption that national supply and demand were roughly in equilibrium in 2006 (the base year of the Physician Supply and Demand Model) and based on trends from 2006 to 2008 we calculate that in 2008 there was a slight shortfall of approximately 250 gastroenterologists.
- Growth in size of the elderly population is projected to increase demand by 1,890 (18%) FTEs by 2020 to 12,510 FTEs.

Actual demand could differ from the baseline projections.

- Factors potentially increasing demand
  - Approximately 61% of the population age 50 and older is regularly screened for CRC (rates vary by age), and CRC screening rates are likely to continue improving. A 10 percentage point increase in the overall screening rate (i.e., raising the rate to 71%) would require an additional 477 FTEs by 2020 to provide the increase in demand for colonoscopies.
  - Future changes in ability to treat gastrointestinal diseases could increase future demand for gastroenterologist services—with the magnitude of such changes unknown.
- Factors potentially decreasing demand
  - Emerging technologies such as computed tomographic colonography, DNA testing, and wireless capsules provide patients with an alternative to the traditional screening colonoscopy. We calculate that a modest shift in screening from standard colonoscopy to other modalities will cause a relatively small decline in demand for gastroenterologists, as positive results from screening tests will still require colonoscopy for diagnosis confirmation and polyp removal.

- Physicians in other specialties currently provide some colonoscopies, and any efforts of these physicians to increase their share of colonoscopies performed would be offset by a decline in demand for gastroenterologist services. However, projected demand for family physicians, general internists, surgeons, and radiologists is growing faster than projected supply, which will limit the ability of physicians in these specialties to provide colonoscopies.
- Rising gastroenterologist productivity could allow each gastroenterologist to care for a larger patient base. Although there is some evidence of productivity increases among gastroenterologists in the late 1990s and early 2000s, there appears to be relatively little increase in productivity in recent years (as measured by average relative value units per gastroenterologist). If, hypothetically, gastroenterologist productivity increased by 1% annually, then by 2020 gastroenterologists would be approximately 12.7% more productive, on average, compared to gastroenterologists in 2008—equivalent to increasing the supply of gastroenterologists (or decreasing demand) by approximately 1,450 FTE gastroenterologists.

Actual supply could differ from the baseline projections. Increasing the number of adult gastroenterology fellows trained each year by approximately 130 (one third increase from current planned levels of 414 new fellows trained per year) starting in 2011, for example, would increase supply by 1,550 FTE gastroenterologists by 2020.

In summary, a shortfall of 1,050 to 1,550 gastroenterologists (8 to 12%) is likely by 2020—due primarily to growth in the size of the elderly population. An increase in CRC screening rates from 61% to 71% of the population age 50 and older regularly screened will have a modest impact on increasing demand for gastroenterologists. This increase could be tempered by a shift in CRC screening away from colonoscopy towards new technologies such as CTC, or it could be larger if CRC screening by fecal occult blood test were replaced with standard colonoscopy that can prevent CRC. Continual increases in gastroenterologist productivity could help mitigate the projected shortfall, but there is little evidence of productivity increases in recent years.

II. Background

Colorectal cancer (CRC) imposes a large medical, economic, and social burden on the United States. Approximately 149,000 new cases will be diagnosed and nearly 50,000 deaths attributed to CRC will occur in 2008.[1] Estimates for 2004 are that national expenditures for treatment of CRC were approximately $8.4 billion and person-years of life lost due to colorectal cancer were 752,000.[2] Research suggests that CRC screening that leads to earlier intervention is effective in reducing mortality[3-6] and can extend life at a cost of $11,890 to $29,725 per life year. [7]

A majority of adults are not receiving regular CRC screening in accordance with national guidelines,[8-10] with the overall screening rate reaching approximately 61% for the population age 50 and older.[11] If national guidelines were followed, an additional 41.8 million average-risk adults would be screened and as many as 60% of deaths from colorectal cancer could be prevented.[12, 13] A growing projected shortfall of physicians could constrain the nation's ability to provide timely access to high-quality health care services and could hinder implementation of national CRC screening guidelines.[14-16]

The conventional modality for CRC screening is colonoscopy and flexible sigmoidoscopy performed by (or under the direction of) a gastroenterologist. In recent years, approximately 14 million colonoscopies and 2-3 million sigmoidoscopies are performed annually, although use of sigmoidoscopies has been declining.[17] Endoscopy accounts for a large portion of the activities and revenue of gastroenterologists, so trends in CRC screening rates and modality have major implications for the supply of and demand for gastroenterologists.[18]

Emerging technologies such as computed tomographic colonography (CTC), DNA testing, and wireless capsules are transforming the field of gastroenterology and provide patients with an alternative to the traditional screening colonoscopy. CTC, which is generally provided by a radiologist, cannot be used for polyp removal and was previously considered to be much less effective than colonoscopy. Today, it is considered to be more comparable for lesions larger than 10mm. [19-23] A 2005 meta analysis suggests that the sensitivity of CTC improves as polyp size increased — 48% for detection of polyps <6 mm, 70% for polyps 6 to 9 mm, and 85% for polyps >9 mm. Recent research finds that CTC has a sensitivity rate of 90% in detecting of adenomas, or cancers ≥ 10mm.[21] No consensus exists as to whether CTC is ready for widespread use, but one study reports that if CTC became the primary modality for CRC screening the number of screening colonoscopies would decline by 27.5%.[24] Approximately 8% of CTC screenings result in a referral for colonoscopy, which mitigates the projected decline in demand for gastroenterologist services with increased use of CTC and other new technologies.[25]

Fecal occult blood test (FOBT) and fecal immunochemical test (FIT), generally administered by primary care clinicians, can be used to detect (but not prevent) CRC. Positive test results require a follow-up colonoscopy for biopsy and/or removal of polyps.

This study analyzes the impact of implementing national CRC screening guidelines and the implications of trends in CRC screening rates and modality on the adequacy of future supply of gastroenterologists through 2020. Specific research questions addressed are the following:

(1) What are the current CRC screening patterns, and how many people will likely receive CRC screening from each modality under alternate scenarios?

(2) How much gastroenterologist time is spent providing CRC-related services, and how will trends in CRC screening rates, technology, and CRC delivery patterns affect the demand for gastroenterologist services?

(3) What is the projected future supply of gastroenterologists, and will supply be sufficient to meet projected future demand?

In the remainder of this report we describe the data and methods used in our analysis, and we discuss study findings and implications.

III. Data and Methods

Estimates of the demand for CRC screening, the current and future derived demand for gastroenterologists, and the current and future supply of gastroenterologists through 2020 come from simulation models that use data from numerous sources. These sources include analysis of national and proprietary databases, findings reported in the peer-reviewed literature, and expert opinion. The projections come from two simulation models:

- The *National Colorectal Screening Model* (NCSM) was originally developed to support analyses for the American Cancer Society and the National Colorectal Cancer Roundtable to model the implications to the Medicare program of improved CRC screening among the pre-Medicare population. We further developed this model to project national CRC screenings across different screening modalities over time.
- The Lewin Group's *Physician Supply and Demand Model (PSDM)* has been used to support workforce analyses for the federal government, professional associations, hospital systems and health plans. Gastroenterologists supply and demand were updated to reflect the most recent data available.

In this section we describe these models, their underlying data sources, and the assumptions used. The study can be broadly partitioned into three major components: modeling future rates and modality of CRC screening, modeling future demand for gastroenterologists, and modeling future supply of gastroenterologists.

Modeling future rates and modality of colorectal cancer screening

Guidelines for CRC screening published jointly by The American Cancer Society, the U.S. Multi-Society Task Force on Colorectal Cancer, and the American College of Radiology—and consistent with the American Gastroenterological Association guidelines — recommend that the population over age 50 be screened regularly.[8, 26] In addition to annual stool tests to detect occult blood or exfoliated DNA, the schedule for structural exams is:

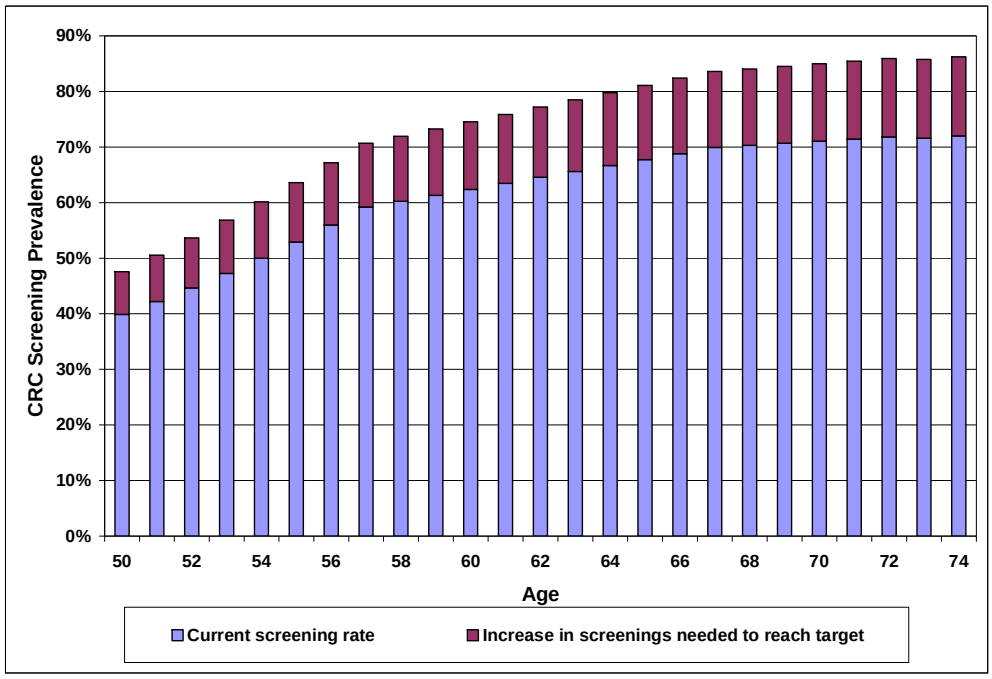
- flexible sigmoidoscopy - every 5 years, or
- colonoscopy - every 10 years, or
- double contrast barium enema every 5 years, or
- computed tomography colonography every 5 years.

People at high risk of CRC may require more frequent structural exams.

A recent analysis by the Centers for Disease control and prevention finds that 60.8% of respondents aged over 50 years to a telephone survey reported having had either an FOBT within 1 year preceding the survey (16.2%) or lower endoscopy within 10 years preceding the survey (55.7%), compared with 56.8% in 2004 and 53.9% in 2002. Analysis of the 2006 Behavioral Risk Factor Surveillance System surveys suggests that the proportion of adults age 50 and older who reported FOBT within the past year and / or endoscopy (sigmoidoscopy and colonoscopy) within the past 10 years ranges from 40% of adults age 50 to over 70% of adults age 70 and older (Exhibit 1). [11] Analysis of the National Health Interview Survey also finds wide variation in screening rates by age and by insurance status (only 24% of adults over age 50 without medical insurance report regular screening) [27, 28]

Our CRC screening analysis focuses on the population currently not being screened, and for this population we model the impact on gastroenterologist time if national screening guidelines were followed. We model scenarios whereby the screening rate increases by 5 and 10 percentage points (such that 66% to 71%—up from 61%—of the population age 50 and older is screened regularly).[1] A 10 percentage point increase in the overall CRC screening rate is achievable when compared to screening rates achieved for other types of cancer. For prostate cancer, 77% of men age 65 and older were screened in the past two years, compared to 59% of men ages 50 to 64.[29] For breast cancer, 67% of women aged 40 and older had a mammogram within the past 2 years.[2]

Exhibit 1. Current Age-Specific Colorectal Cancer Screening Rates with Additional Screenings Needed to Reach a 71% Rate



Source: 2006 Behavioral Risk Factor Surveillance System for current screening rates.

[1] The estimated increase in gastroenterologist demand from the hypothetical 10% CRC screening increase scenario is independent of the nation's current screening rate.

The logic behind the National Colorectal Screening Model and the approach used to estimate the increase in amount of gastroenterologist time required to provide services under alternate scenarios of future CRC screening rates and changes in technology is illustrated in Exhibit 2. Several scenarios are modeled to estimate gastroenterologist demand—ranging from a status quo scenario that assumes no changes in screening rates and distribution of screenings across modalities, to scenarios that assume an increase in proportion of people screened and greater use of emerging technologies. Screening colonoscopies and screenings using alternative approaches have a certain probability of testing positive for polyps or CRC, and this population that tests positive is likely to undergo diagnostic colonoscopy to confirm test results and to remove polyps. People receiving a polypectomy and treatment for CRC are categorized as part of the high risk population.

Based on the decision tree, the major steps of the model include:

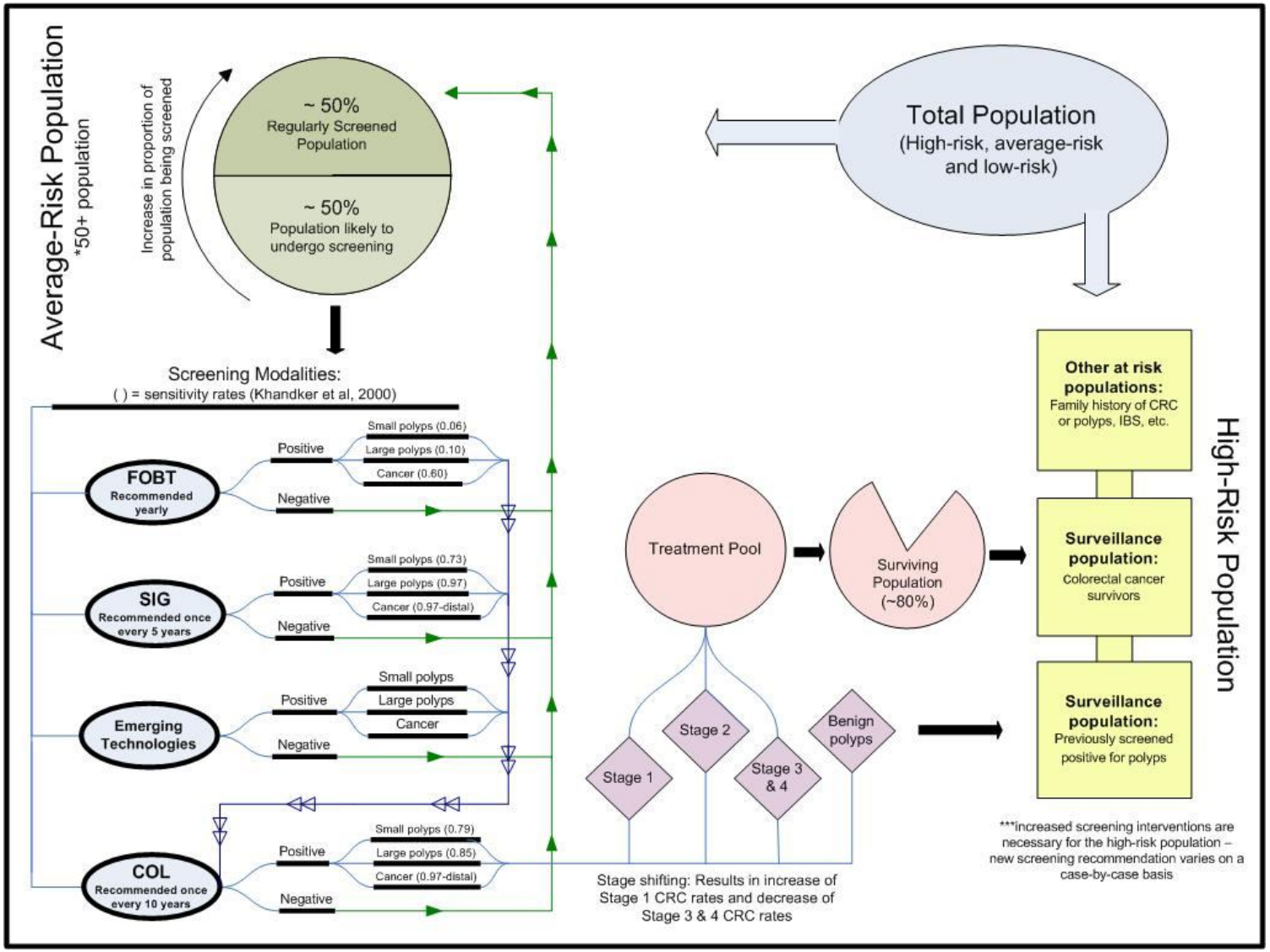
- Determination of the target population that could be screened under an increased screening program,
- Distribution of screening modalities and assumed take-up rates under an increased screening program, and
- Estimating size of the population diagnosed with polyps and CRC due to improved screening.

Determination of target population that could be screened under an increased screening program

The model starts with the population of adults in 2008 age 50 to 77 that are not receiving regular CRC screening. The U.S. Preventive Services Task Force (USPSTF) recommends against routine CRC screening in adults age 76 to 85, and recommends against CRC screening in the over age 85 population.[30] Hence, the model simulates the impact of CRC screening through age 75. In addition to each of the 26 (age 50 to 75) age groups being considered as a separate cohort, the model also replenishes the age cohort. For instance, in year 2009, the 50 year old population turns 51 and a new 50 year old age cohort undergoes increased screening. Members of each cohort have a probability of undergoing increased screening in 2008 and each future year.

For each year's iteration, the model ages individual cohorts and assumes additional CRC screenings under different scenarios. The status-quo estimate is based on current age-specific CRC screening rates; the estimate for additional screenings is based on the projected change in annual screening rate.

Exhibit 2. Logic Model for Colorectal Cancer Screening



Distribution of screening modalities and assumed take-up rates under an increased screening program

For each cohort we model the increase in the proportion of those receiving CRC screening by modality under the following scenarios (Exhibit 3). Under each of the scenarios except the baseline, we assume an increase in the screening rate for the unscreened population over the study period. For each cohort turning 50, we assume that 50% of the newly screened use FOBT / FIT, 11% use sigmoidoscopy and 39% use colonoscopy. We assume a continued decline in use of flexible sigmoidoscopy replaced by colonoscopy. In our scenario for growth in technology, we assume that CTC use grows to replace 10% of screening colonoscopy by 2020. The newly screened population is assumed to adhere to the screening guidelines in terms of the periodicity of the tests for both screening and surveillance populations.

Positive FOBTs, sigmoidoscopies, and CTCs are assumed to be followed by a diagnostic colonoscopy. We also assume that once an individual has a positive FOBT, sigmoidoscopy, or CTC, he or she will remain in a colonoscopy screening or surveillance cycle and does not revert to FOBT, sigmoidoscopy, or CTC. A five year surveillance interval of colonoscopy is assumed following the detection of a cancer or polyp.

Exhibit 3. Colorectal Cancer Screening Scenarios Modeled

		Screening Rates	
		No Change	**Improvement**
Technology and Productivity	**No change**	• **Baseline**. This scenario assumes that current age-gender screening rates will be constant over time, and the current distribution of screenings across modality will remain constant. Growth in number of CRC screenings comes solely from changing demographics.	• **Improved screening**. This scenario assumes the nation achieves a 10 percentage point increase in the screening rate (reaching 71%) for the age 50 and older population following national CRC guidelines.
	Advances in technology	• **Modality shift**. This scenario assumes that sigmoidoscopy use declines by 2012, and that 10% of structural screening exams are performed by CTC 2020.	• **Most likely**. This scenario assumes the nation achieves a 10 percentage point increase in the screening rate for the age 50 and older population, and new technology (such as CTC) provides 10% of structural screening exams by 2020.

Estimating population diagnosed with polyps and CRC from improved screening

We estimate the number of the newly screened population diagnosed with CRC as a result of increased screening. The maximum number of people that can be diagnosed with CRC screening includes the product of the age-specific incidence rates and the newly screened population. However, the sensitivity of each of the modalities will only allow the detection of

CRC incidence of a certain proportion of that population. For instance, if the CRC incidence at age 51 is 0.050% then for every 10,000 people screened, there will be 5 people diagnosed with CRC. Of the 10,000 people screened, the distribution of CRC by modality is 5,000 FOBT/FIT, 1,100 sigmoidoscopy, and 3,900 colonoscopy. If the sensitivity for cancer of FOBT/FIT is 40%,[31] then the estimated population diagnosed with CRC by FOBT/FIT is: 5,000 * 0.40 * 0.00050 = 1.

The cancer sensitivity rate for sigmoidoscopy and colonoscopy is 47% and 95% respectively.[32]

Similar to the incidence of CRC, the age-specific polyp prevalence rates are applied to the newly screened population to estimate the size of the population with polyps among the newly screened population.[33] The detection of polyps is also dependent upon the sensitivity of the CRC screening modalities to detect polyps.

The biggest impact of the increase in CRC screening is likely to be the reduction in CRC incidence rate of the study population over time and a shift in the distribution of CRC stage at presentation. Literature indicates that the CRC incidence rate would decrease over time at the end of study by 40% for FOBT and 85% for colonoscopy. The reduction in incidence rates and stage shift eventually leads to an increase in the size of the surveillance population. As the surveillance population is likely to undergo colonoscopy every five years, an increase in the surveillance population affects the demand for gastroenterologists.

Modeling gastroenterologist demand

Current and future demand for gastroenterologists is determined by trends in health care use patterns, demographics, socioeconomic factors, and health care delivery patterns. Over time, advances in technology, changes in reimbursement rates for health care services, changes in clinician training, and economic forces can influence patterns of health care use and delivery. We model a baseline scenario of future demand where we extrapolate current health care use and delivery patterns to the future U.S. population. In addition, we model alternate scenarios with different assumptions about CRC screening rates and screening modality.

Barclay et al (2006), based on a survey of 12 gastroenterologists whose workload was tracked for 15 months, report that gastroenterologists provide approximately 11 colonoscopies per week.[34] Estimates from Seeff et al. (2004) put the number at approximately 30 colonoscopies per gastroenterologist per week.[17] Combining:

(1) the 30/week estimate from Seeff et al.;

(2) data from the 2009 CMS Practice Expense Data File that gastroenterologists average approximately 70 minutes with each patient who receives a colonoscopy (including consult, time associated with colonoscopy procedure, and pre-and post procedure time) and 84 minutes when a biopsy is required; and

(3) estimates from survey data (described later) for 623 gastroenterologists that gastroenterologists spend approximately 50 hours per week in patient care activities;

suggests that gastroenterologists spend approximately 72% of their patient care hours, on average providing services related to colonoscopies (including related consultations).

Current patterns of health care utilization

Overall demand for gastroenterologists (including time spent providing non-CRC related services) is derived from the demand for health care services, combined with patterns of health care delivery. To model the implications of changing demographics on demand for gastroenterologists, we use current health care utilization and delivery patterns to calculate physician-to-population ratios for subsets of the population differentiated by age, gender, race/ethnicity, and insurance status. These physician-to-population ratios are then applied to Census Bureau projections of the future U.S. population.

The approach starts with total active gastroenterologists engaged primarily in patient care activities, which was approximately 10,310 in 2006, and estimates of the proportion of physician time spent providing patient care in different activities. According to American Society for Gastrointestinal Endoscopy (ASGE) experts, the estimated proportion of gastroenterologist patient care time spent in office visits, emergency and outpatient visits, hospital rounds, and procedures is, respectively, 26%, 8%, 6%, and 60% (Exhibit 4). These estimates are used to calculate full time equivalent (FTE) gastroenterologists by activity. For example, an estimated 26% of gastroenterologists' time is spent providing office visits. Multiplying 26% by 10,310 implies 2,680 FTE gastroenterologists needed to provide office visits under current utilization patterns in 2006.

Exhibit 4. FTE Gastroenterologist Utilization by Patient Care Activity, 2006

Activity	Proportion of Patient Time Spent*	Estimated Full Time Equivalent Physicians in 2006
Total	**100%**	**10,310**
Office visits	26%	2,680
Hospital outpatient and emergency visits	8%	820
Hospital rounds	6%	620
Procedures	60%	6,190

Source: * Estimates from American Society for Gastrointestinal Endoscopy experts. Note: The baseline gastroenterologist demand projections (based on changing demographics) are relatively insensitive to the estimated proportion of patient care time spent in each of these patient care activities because the demographic mix of patients seen in each setting is relatively similar—with the exception that the patient mix receiving hospital rounds tends to be older than the patient mix seen in ambulatory settings.

Then, using national data on health care use, we estimate the share of health care services in each activity that is provided to different population groups. For example, if 10% of office visits were provided to a specific demographic group, then that demographic group currently uses 268 (10% of 2,680) FTE gastroenterologists for office visits. We use this approach to construct physician-to-population ratios for 112 subsets of the population defined by age (0 to 5, 6 to 17, 18 to 20, 21 to 44, 45 to 64, 65 to 74, 75 and older), gender, race/ethnicity (non-Hispanic white, non-Hispanic black, non-Hispanic other, Hispanic), and whether insured. These physician-to-population ratios were developed using FTE physician counts in 2006 that exclude physicians still in fellowship programs. Consequently, to assess the future adequacy of supply, the demand projections should be compared to FTE patient care supply excluding fellows. These detailed

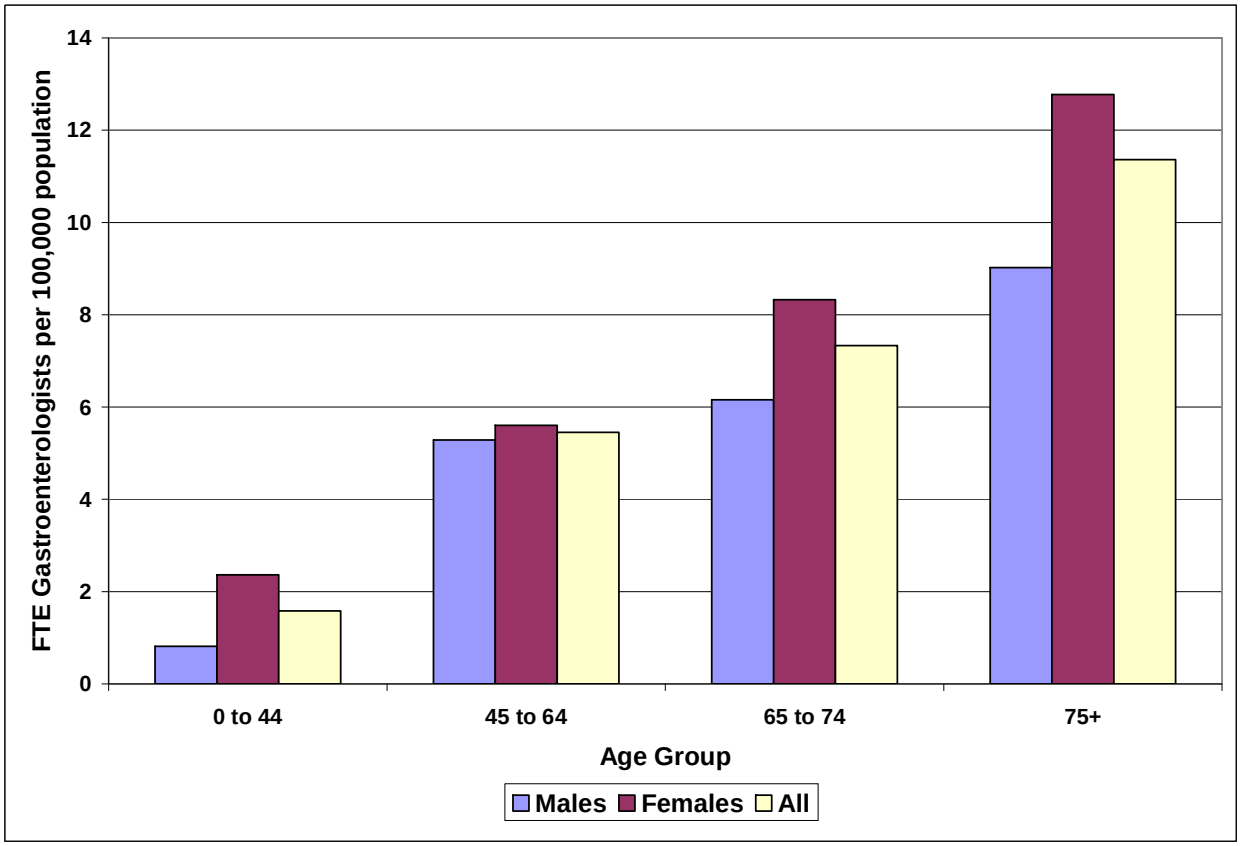
physician-to-population ratios reflect current national patterns of healthcare utilization and delivery.

Sources used to estimate current patterns of health care use include the following:

- **2006 National Ambulatory Medical Care Survey** is used to estimate the demographic distribution of patients who receive physician office visits and the average physician time (in minutes) per visit. Physician time is calculated based on self-reported doctor time collected by the survey. This information is used to calculate gastroenterologist-to-population ratios for office-based care.
- **2006 National Hospital Ambulatory Medical Care Survey** is used to estimate the demographic distribution of patients who received care during hospital emergency and outpatient visits, and estimate associated physician time. This file does not indicate specialty of the attending or consulting physician, so patient primary diagnosis codes are used to identify the likely specialty of the physician. This information is used to calculate gastroenterologist-to-population ratios for hospital emergency and outpatient care.
- **2006 Nationwide Inpatient Sample** is applied to estimate the demographic distribution of patients who received care during hospital admissions. This file does not identify physician specialty, but patient primary diagnosis code is used to indicate the likely specialty of the attending physician. This information is used to calculate gastroenterologist-to-population ratios for hospital rounds.
- **2006 National Survey of Ambulatory Surgery** is used to estimate the demographic distribution of patients who received ambulatory surgical care in hospital-based and freestanding ambulatory surgery centers. Physician specialty and associated doctor time is self reported and collected by the survey. Information about time spent in ambulatory surgery is combined with time spent providing inpatient surgery to calculate gastroenterologist-to-population ratios for surgical care.

The resulting physician-to-population ratios, which vary by demographic group and patient care setting, are summarized by age group in Exhibit 5. Women age 75 and older currently use gastroenterologist services at a rate of 12.8 FTE gastroenterologists per 100,000 population, while males under age 45 use services at a rate of 0.8 FTE gastroenterologist per 100,000 population.

Exhibit 5. FTE Gastroenterologist Use per 100,000 Population, 2006



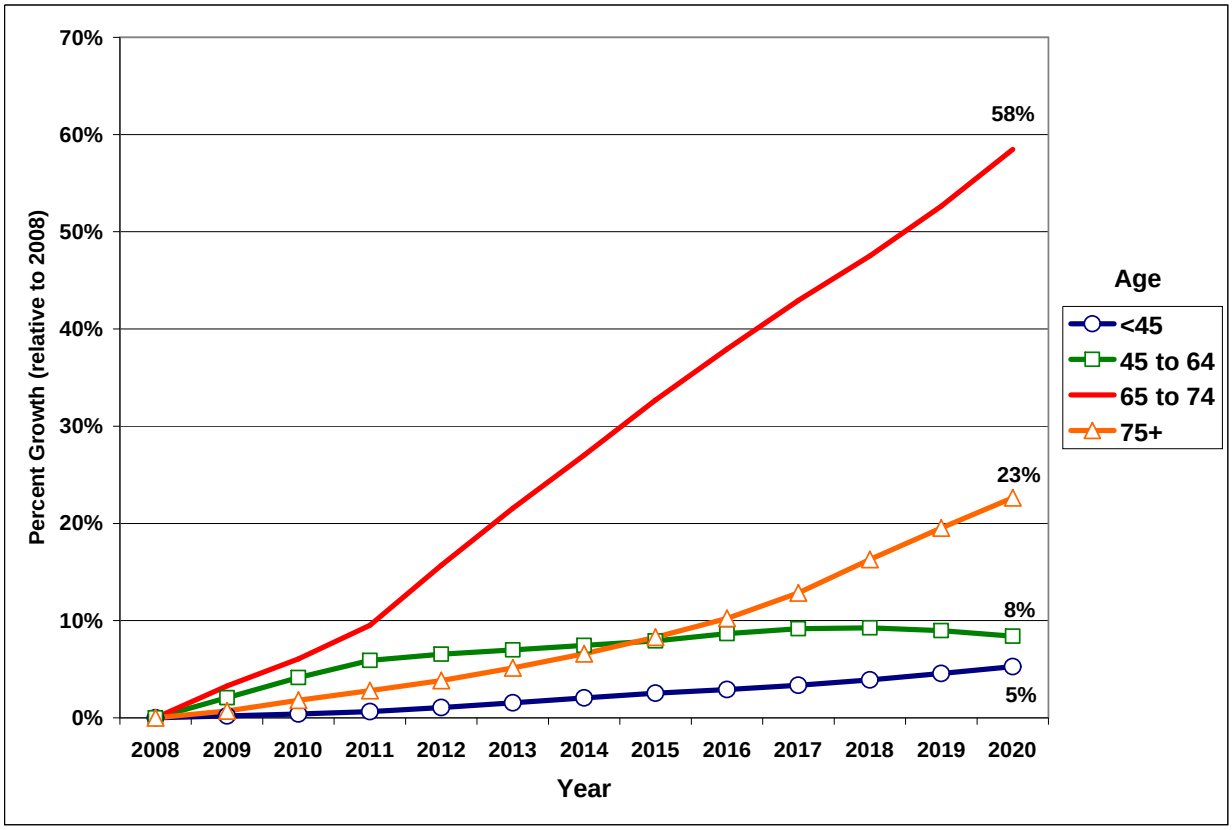
Source: Estimates from the Physician Supply and Demand Model.

Modeling future demand due to changing demographics

U.S. Census Bureau projections show a population that is growing, aging, and becoming more racially and ethnically diverse. Between 2008 and 2020, the U.S. population is projected to grow 11%, from 303.6 million to 335.8 million. Projected growth rates (Exhibit 6) are substantially higher for the population age 65 to 74 (58% growth) relative to the under age 45 population (5% growth).

To model the impact of changing demographics on demand for health care services, we multiply the gastroenterologist-to-population ratios and population projections by age, gender, and race/ethnicity. The proportion of the population with medical insurance, as measured by analysis of the 2006 National Health Interview Survey, is assumed to remain constant over time within each demographic group.

Exhibit 6. Percent Growth in Population (relative to 2008)



Source: Analysis of Census Bureau population projections.

Modeling the impact on demand due to changing CRC screening rates and modality

The approach to model changes in CRC screening rates and modality is described previously. The number of screenings / procedures by modality is multiplied by the probability that a gastroenterologist provided the service and multiplied by the average number of minutes gastroenterologists spend with patients per service provided (Exhibit 7). This calculation provides an estimate of additional total national physician minutes providing CRC screening and polypectomy. To calculate additional FTE gastroenterologists needed to provide the additional screening, we divide the national estimate of additional minutes needed by the average minutes in patient care per gastroenterologist per year (144,000 patient care minutes per year= 48 weeks per year in professional activities × 50 hours / week in patient care × 60 minutes / hour). Gastroenterologists spend an estimated 70 minutes with each patient who receives a colonoscopy (84 minutes when a biopsy is provided)—including consult, time associated with colonoscopy procedure, and pre-and post procedure time. Consequently, approximately 1 additional FTE gastroenterologist is needed for each 2000 additional colonoscopies performed.

Exhibit 7. Estimates of Gastroenterologist Involvement in CRC Screening and Polyp Removal

	Estimate Used	Source
Percent of services performed by gastroenterologists		
Sigmoidoscopy	43.7%	43.7%--Seeff et al. (2004)[17] Alternative estimates include: 37%--Meyer (2000)[35] 25%--Brown (2003)[36] 28.70%--Wilkins (2007)[37]
Colonoscopy	82.5%	82.5%--Seeff et al. (2004) [17] Alternative estimates include: 73%--Meyer (2000)[35] 66%--Brown (2003)[36]
Polyps removal (in additional to colonoscopy)	70%	Estimate
CT colonography	0%	
Gastroenterologist time (minutes) spent with patients receiving service		
Sigmoidoscopy	18 min	Olympus EndoSite(TM) Consulting convenience sample of 24 gastroenterologists (average of 20 responses); estimate includes time to perform the procedure, pre and post time, and all time spent with the patient to discuss results and to review patient records
Colonoscopy	70 min	CMS Practice Expense Data File for 2009
Polyps removal (in additional to colonoscopy)	14 min	CMS Practice Expense Data File for 2009
CT colonography	NA	

Note: Seeff et al. numbers were used in this analysis for consistency in terms of total number of colonoscopies and sigmoidoscopies performed annually, and percent of procedures performed by gastroenterologists.

Meyer (2000) reports estimates of the proportion of flexible sigmoidoscopies performed by general surgeons (8.6%), colorectal surgeons (11.6%), internists (27.6%), and family medicine physicians (12.8%).[35] Brown (2003) reports estimates of the proportion of flexible sigmoidoscopies performed by general surgeons (10%) and internists (36.3%).[36] Seeff et al. (2004) report that 25% of sigmoidoscopies are performed by primary care physicians.[17]

Meyer (2000) reports estimates of the proportion of colonoscopies performed by general surgeons (13%), colorectal surgeons (6.3%), internists (5.3%), and family medicine physicians (1.1%).[35] Brown (2003) estimates that 30.4% of colonoscopies are performed by general surgeons.[36] Seeff et al. (2004) report that 2% of colonoscopies are performed by primary care physicians.[17]

Using the PSDM, we project the future adequacy of supply of general surgeons, general and family practitioners, and general internists under a baseline scenario where changing demographics is the primary demand driver. Future adequacy of supply of these specialties has implications for the gastroenterologist workforce to the extent that a shortfall (surplus) of physicians in these specialties might decrease (increase) the extent to which physicians in these specialties expand their scope of practice by performing a greater proportion of the nation's colonoscopies and sigmoidoscopies.

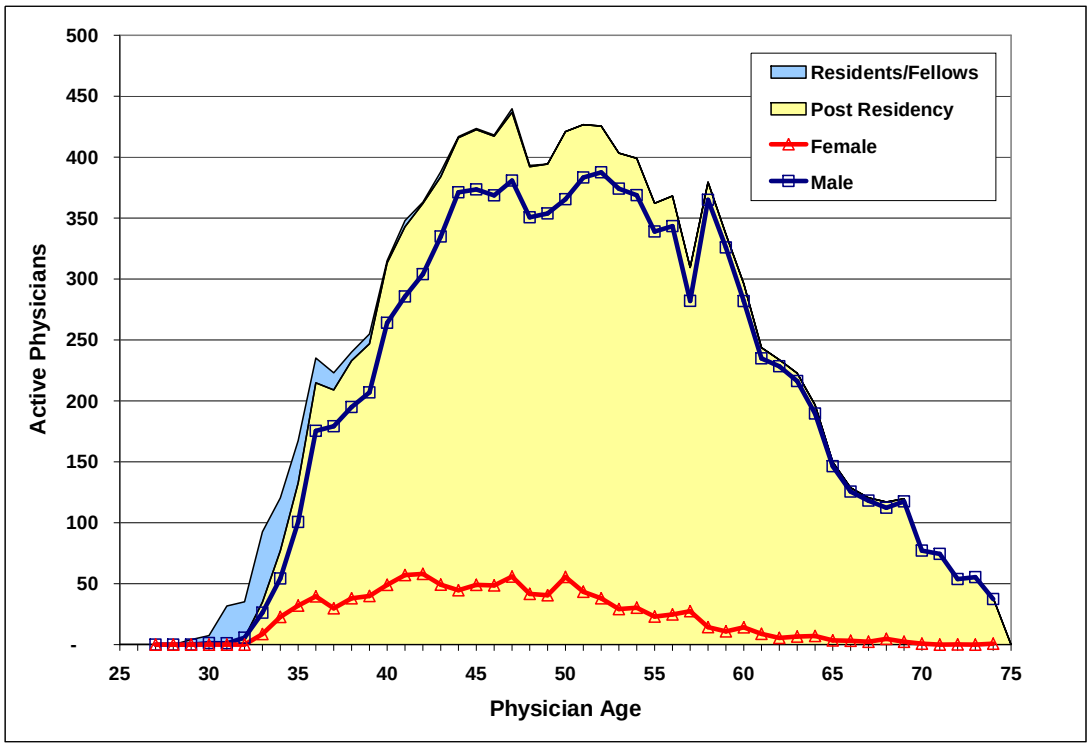
Modeling gastroenterologist supply

To assess whether there will be sufficient supply to meet projected future demand for gastroenterologists, we project future supply using the PSDM. We use an "inventory model" approach that starts with the supply in 2006, adds annual estimates of the number fellows completing training, subtracts estimates of mortality and retirement, and adjusts to FTE supply to take into consideration changes in average hours worked over time as the demographic mix (age and gender) of gastroenterologists changes.

Current supply

Estimates of current supply come from the 2006 American Medical Association (AMA) Masterfile. AMA (2005 data) reports 11,366 physicians categorized as "active" in patient care (defined as working 20 or more hours per week in patient care activities) who report their primary specialty as gastroenterology. [38] Using an algorithm developed by The Lewin Group for the Association of American Medical Colleges (AAMC), we adjust the AMA numbers downward to reflect concerns that the Masterfile overestimates active supply because of the delay in when physicians retire and when their status is updated in the Masterfile. This adjustment is based on analysis of a survey by AAMC of physicians over age 50, in which some older physicians were listed as active in the Masterfile but in the survey reported that they had retired. The adjustment varies by physician age, gender, and activity status reported in the Masterfile. We include in the supply estimate only physicians under age 75 and exclude fellows in training (Exhibit 8). After the adjustment, we estimate 10,997 active gastroenterologists in 2006, of which 10,310 are primarily engaged in patient care. These estimates include both adult and pediatric gastroenterologists.

Exhibit 8. Age Distribution of Gastroenterologists



Source: Analysis of AMA Masterfile.

Fellowship completions

In the 2006-2007 academic year at training programs accredited by the Accreditation Council for Graduate Medical Education, 365 physicians completed a fellowship in adult gastroenterology and 55 completed a fellowship in pediatric gastroenterology.[39] The number of fellows completing training has grown slightly in recent years, with an expected 483 entering their first year clinical position beginning in July 2009 (including 403 in adult, 69 in pediatric, and 11 in osteopathic).[40] The baseline scenario modeled assumes that from July 2011 onward, 483 complete their gastroenterology training each year.[2] Two alternate scenarios modeled include an increase to 583 new gastroenterologists, and a decline to 383.

A 2007 survey of 160 gastroenterology training program directors (with 94 responses) by the American Gastroenterological Association Institute found the following trends in supply determinants:[41]

- Approximately 29% of fellows are women, up from 18% in 2001-2002.
- Approximately 20% of fellows are foreign medical graduates with no significant change over the past five years.

[2] Note: The supply model does not differentiate between adult and pediatric gastroenterologists, although the demand model can differentiate demand for gastroenterologists by patient age. Consequently, when projecting future adequacy of gastroenterologist supply this analysis includes both supply and demand for all gastroenterologists.

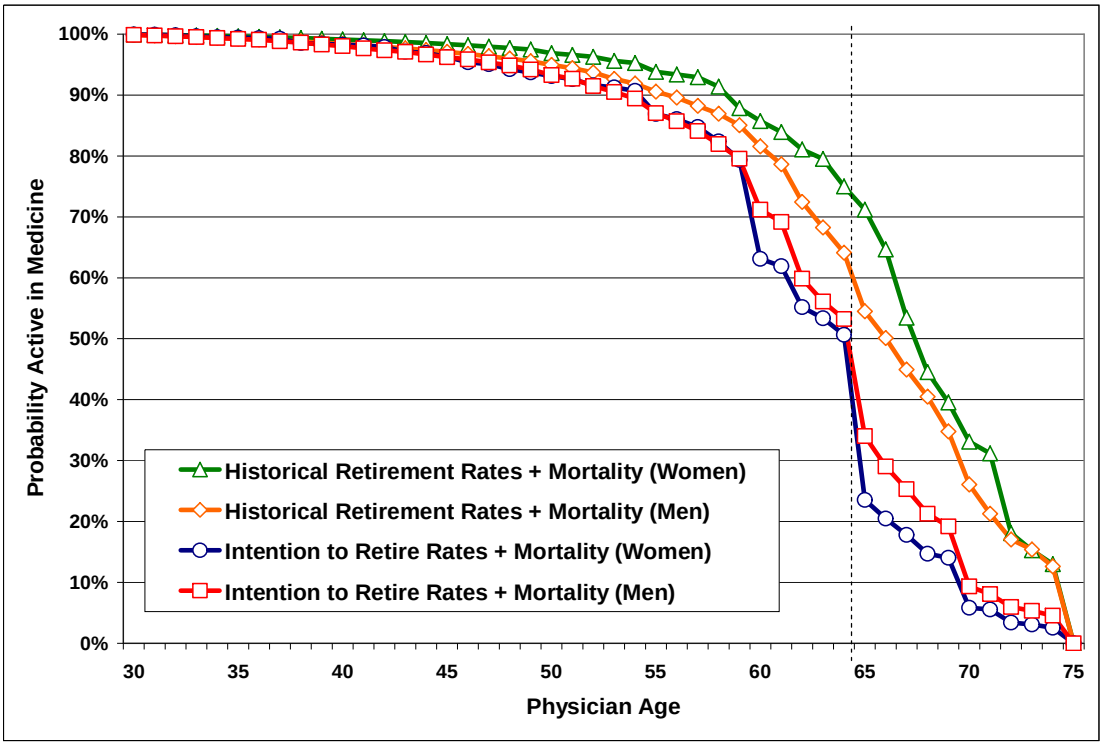
- Almost two-thirds of GI fellows are in a clinical practice track, 16% are in a clinical investigation track, 13% are in a clinical education track, and 6% are in a basic investigation track. This has not changed significantly over the past five years.

Our supply inputs and assumptions are consistent with these trends.

Workforce attrition

Each year, physicians leave clinical practice through retirement, mortality, and disability. Retirement rates for gastroenterologists are not readily available, so we use retirement rates for all physicians as estimated using the AAMC Survey of Physicians Over Age 50. We combine these retirement rates with mortality rates from the Centers for Disease Control and Prevention to calculate attrition rates that are used to estimate the probability that a physician of a given age and gender will be active in medicine (Exhibit 9). Estimates of mortality rate, are adjusted to reflect that physicians under age 65 have lower mortality rates than people in other occupations.[42] The AAMC survey collected age at retirement for those physicians who had already retired, and collected expected age of retirement for all physicians. For the baseline supply projections we use historical retirement rates, as physicians have historically continued to work past the ages they intend to retire (age 62 and 65 are the most often reported age when physicians intend to retire). If physicians nearing retirement start to retire younger than did earlier cohorts, then the future shortfall of physicians could be even larger than we project. These retirement rates reflect averages over multiple years, although in individual years actual retirement rates will fluctuate due to fluctuations in the stock market and other factors.

Exhibit 9. Physician Activity Rates

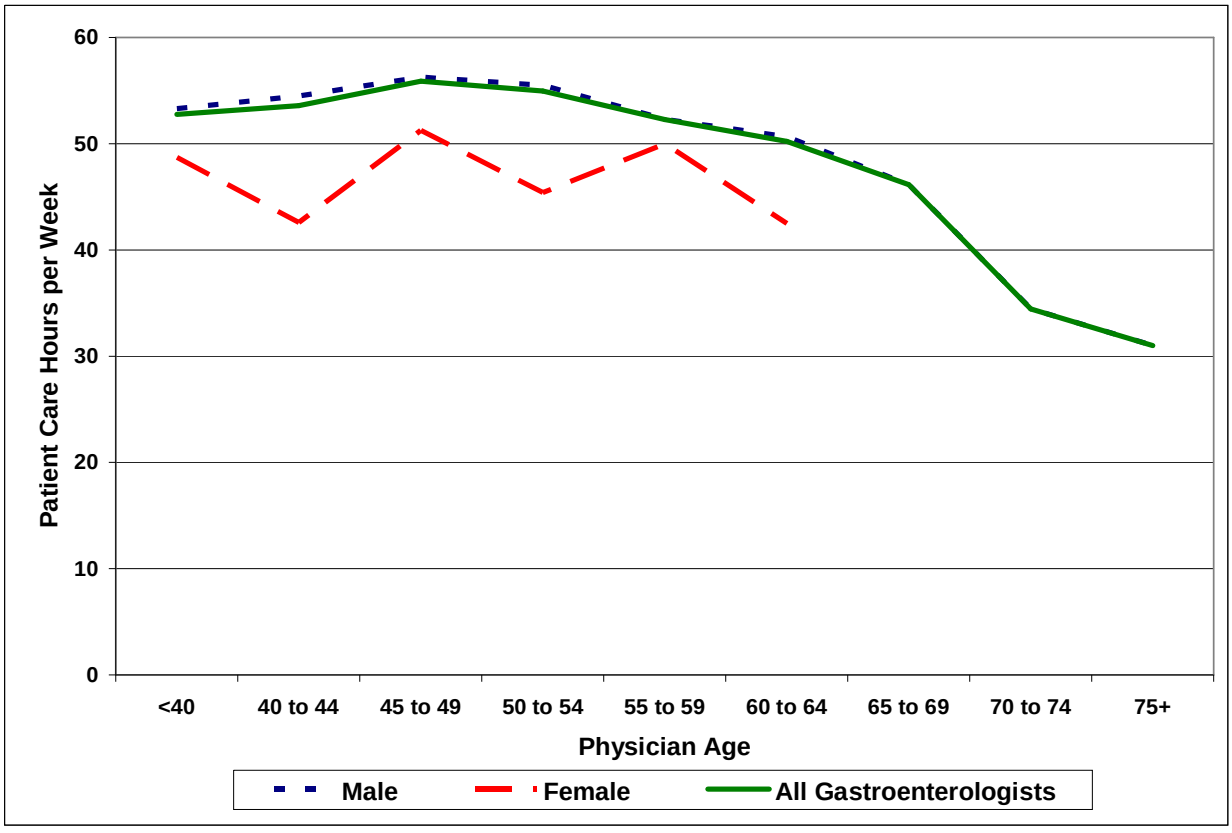


Source: Analysis of AAMC Survey of Physicians Over Age 50 combined with CDC mortality rates.

Patient care hours worked

Information on gastroenterologist hours worked in patient care come from a 2002-2003 survey sponsored by the Bureau of Health Professions and collected by AMA as part of the process to update its Masterfile. Of the 46,794 physicians contacted who reported average hours worked per week in patient care, gastroenterology is the primary specialty for 655—of which 623 meet the AMA definition of active. For the 581 active males and 42 active females, we calculated average patient care hours worked per week by age group (Exhibit 10). For the age 60 and older groups, there were insufficient number of women to separately estimate average hours worked by gender. Across all 623 physicians, average hours are 53 per week (which when sex-age adjusted to match demographics of the current gastroenterologist workforce equates to an average of 50 patient care hours per week). Dividing average hours for each demographic (age group and gender) by the national total, we calculate an FTE rate that converts future estimates of active supply to their equivalent in 2006. If the average age of gastroenterologists rises (falls), then FTE supply grows slower (faster) than active supply.

Exhibit 10. Gastroenterologist Average Patient Care Hours per Week



Source: Analysis of BHPr 2002-2003 Physician Hours Survey.

IV. Results

Using the *National Colorectal Screening Model* and the *Physician Supply and Demand Model*, we project the additional number of CRC screenings from anticipated improvements in CRC screening rates and adequacy of gastroenterologist supply between 2008 and 2020.

Future colorectal cancer screenings and added demand for gastroenterologists

If the nation gradually achieves a 10 percentage point increase in the CRC screening rate over the next decade as the 50-year-old cohort ages to 60, under the scenario modeled the total annual number of screenings (beyond the anticipated growth associated with an aging population) **increases by approximately 600,000 in the short term and by approximately 1,500,000 by 2020** (Exhibit 12).

Under the modeled scenario, the number of colonoscopies would increase in the near term by approximately 279,000—231,000 screening colonoscopies and 48,000 diagnostic / therapeutic colonoscopies (Exhibit 13). By 2020, the number of total colonoscopies from higher screening rates would be 670,000 —538,000 screening colonoscopies and 132,000 diagnostic / therapeutic colonoscopies higher than demanded if age-adjusted screening rates remain unchanged from current levels (equivalent to the needed for an additional 477 FTE gastroenterologists). Due to the 10 year cycle for receiving a colonoscopy, for the scenarios whose initial year is 2008 we observe a spike in the number of colonoscopies (and thus demand for gastroenterologists) from 2018 onwards.

We model scenarios where new technologies (CTC is used for this example) replace 10% of screening colonoscopies. The projected demand for gastroenterologists varies depending on the targeted screening. If the shift in screening modalities is applied only to the additional screenings from the 10% screening increase scenario, then growth in FTE demand for gastroenterologists in 2020 would be 451 (rather than 477 FTEs).

When considering all screening colonoscopies performed, we calculate that for each 10% of screening colonoscopies performed by CTC (versus traditional colonoscopy), the demand for gastroenterologists declines by a modest 290 FTEs. This estimate is based on the prevailing rate of approximately 14.2 million colonoscopies performed each year according to Seeff et al., and an estimate that 6.4 million of these colonoscopies are for screening.[17]

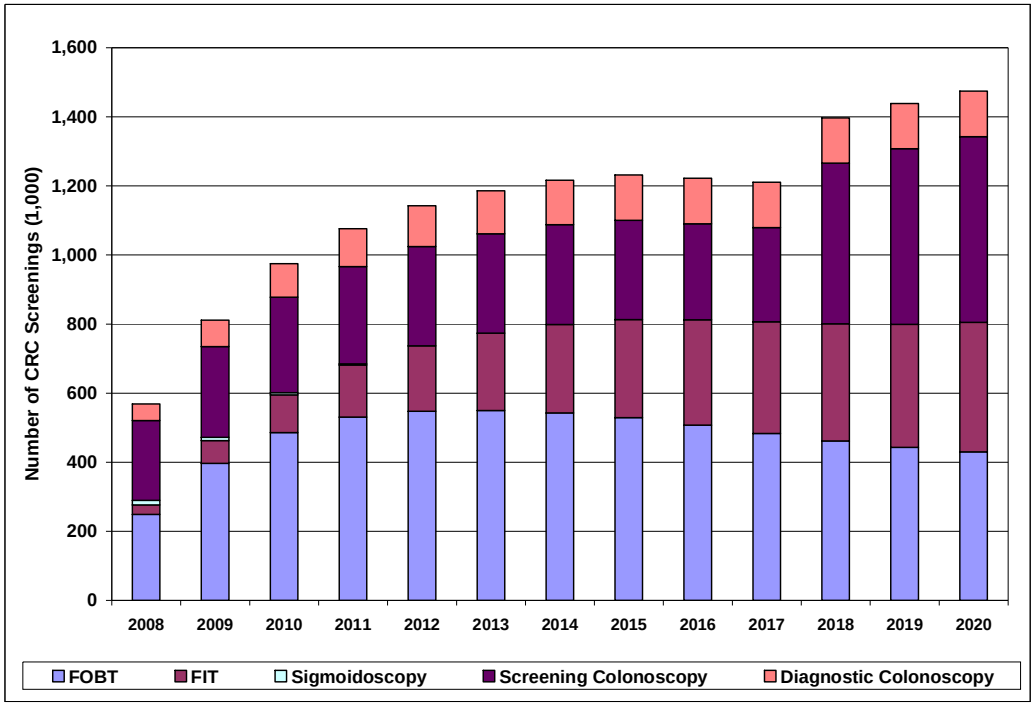
The baseline supply and demand projections for gastroenterology suggest a growing shortfall—reaching approximately 1,050 FTEs (8%) by 2020 (Exhibit 11). Under a scenario where CRC screening rates improve—approaching 71%—the shortfall of gastroenterologists rises to approximately 1,550 (12%) by 2020.

Exhibit 11. Projected Shortfall of Gastroenterologists in 2020 under Alternate Colorectal Cancer Screening Scenarios

		Screening Rates	
		No Change	**Improvement**
Technology and Productivity	**No change**	• **Baseline**. This scenario assumes that current age-gender screening rates will be constant over time, and the current distribution of screenings across modality will remain constant. Growth in number of CRC screenings comes solely from changing demographics. • **1,050 FTE shortfall**	• **Improved screening**. This scenario assumes the nation achieves a 10 percentage point increase in the screening rate (reaching 71%) for the age 50 and older population following national CRC guidelines. • **1,550 FTE shortfall**
	Advances in technology	• **Modality shift**. This scenario assumes that sigmoidoscopy use declines by 2012, and that 10% of structural screening exams are performed by CTC 2020. • **780 FTE shortfall**	• **Most likely**. This scenario assumes the nation achieves a 10 percentage point increase in the screening rate for the age 50 and older population, and new technology (such as CTC) provides 10% of structural screening exams by 2020. • **1,280 FTE shortfall**

Exhibit 12. Projected Modality Distribution Colorectal Cancer Screenings Associated with a 10% Increase in the Screening Rate

Screening Rate Increase Only



Screening Rate Increase Plus Technology Change

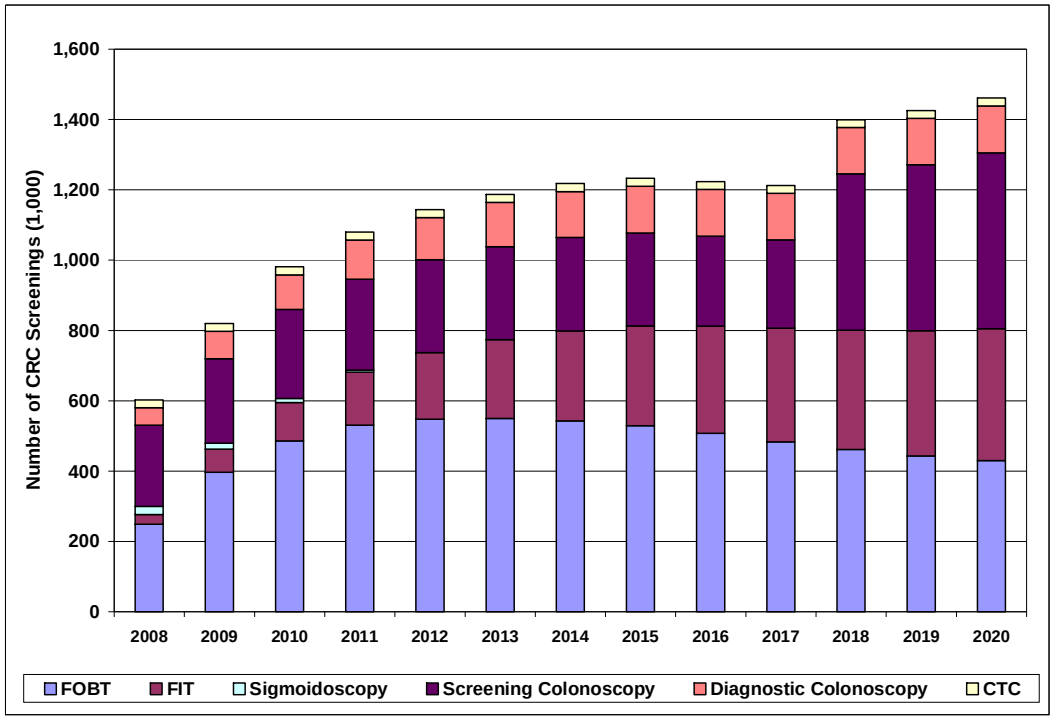


Exhibit 13. Projected Number of Additional Colonoscopies and FTE Gastroenterologists Needed

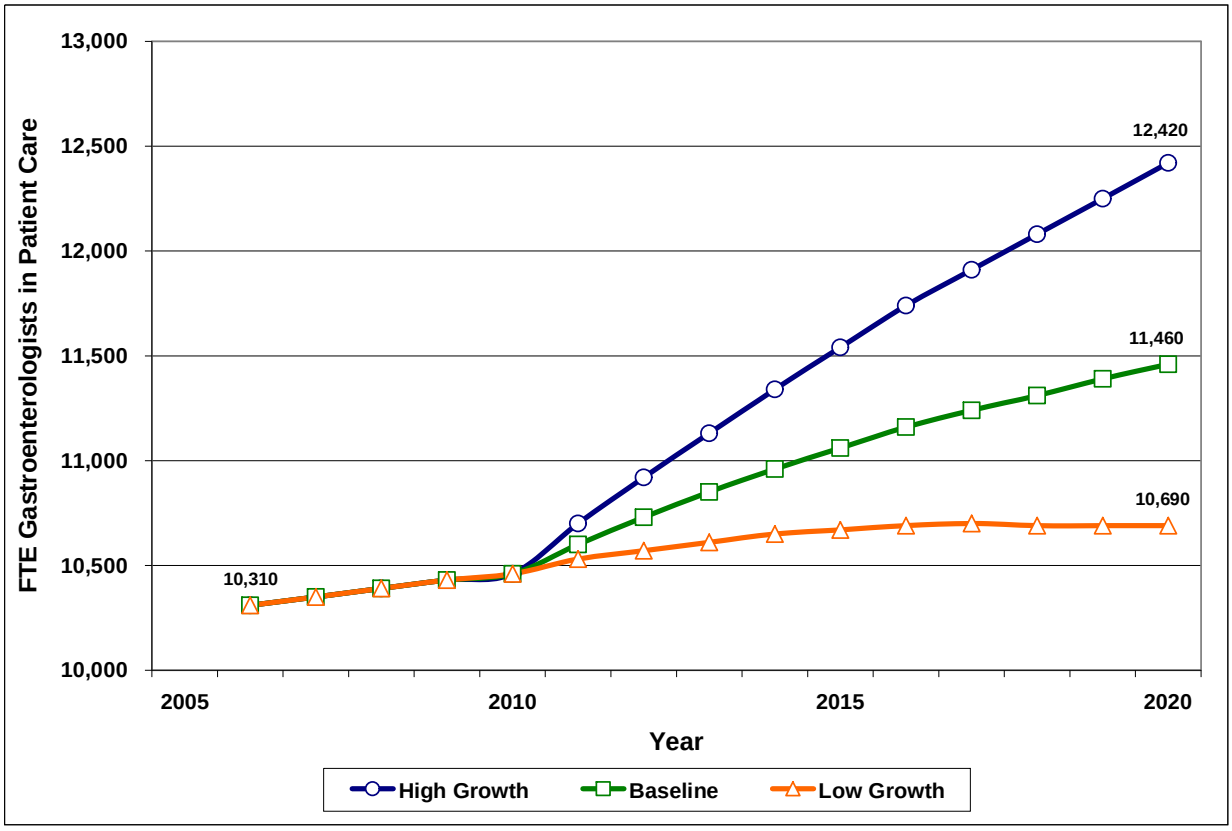
Scenarios	Increase screening rate by 5%			Increase screening rate by 10%			Increase screening rate by 10%, with 10% of screening colonoscopies replace by CTC		
Year	Screening Colonoscopies	Diagnostic /Therapeutic Colonoscopies	FTE Gastroenterologists	Screening Colonoscopies	Diagnostic /Therapeutic Colonoscopies	FTE Gastroenterologists	Screening Colonoscopies	Diagnostic /Therapeutic Colonoscopies	FTE Gastroenterologists
2008	130,727	27,173	70	231,125	48,041	123	231,125	49,311	124
2009	148,521	43,163	85	262,585	76,313	150	240,238	77,593	141
2010	156,369	54,707	94	276,461	96,722	166	253,422	98,044	157
2011	159,354	62,100	99	281,739	109,792	175	258,740	111,114	165
2012	162,498	66,798	103	287,296	118,098	181	264,313	119,421	172
2013	162,738	70,352	112	287,721	124,382	197	264,703	125,705	188
2014	163,439	72,861	115	288,960	128,818	203	265,843	130,149	192
2015	162,430	74,384	116	287,176	131,510	205	264,202	132,832	195
2016	157,049	74,572	115	277,663	131,843	203	255,450	133,122	193
2017	154,315	74,251	115	272,829	131,276	203	251,003	132,536	193
2018	263,146	73,950	227	465,241	130,744	402	444,469	132,001	393
2019	287,505	73,973	253	508,309	130,785	448	471,895	132,050	423
2020	304,109	74,661	270	537,664	132,001	477	500,217	133,301	451

Projected adequacy of gastroenterologist supply

The supply of active gastroenterologists is projected to grow from approximately 11,123 in 2008 to 12,813 by 2020 (a 15% increase). The number of FTE gastroenterologists in patient care is projected to grow at a slightly slower rate, due to the increasing proportion of gastroenterologists who are women and an increase in average age which combined are projected to reduce average hours worked per week, with supply increasing from 10,390 to 11,460 (10%) between 2008 and 2020 (Exhibit 14).

We project FTE supply in patient care under three scenarios: (1) a baseline scenario that assumes 483 fellows completing their graduate medical education each year starting in 2011 (up from 358 in recent years), (2) a high growth scenario that assumes 583 fellows per year, and (3) a low growth scenario that assumes 383 fellows per year. We use the baseline supply for comparison to the demand projections.

Exhibit 14. Projections of FTE Supply of Gastroenterologists in Patient Care



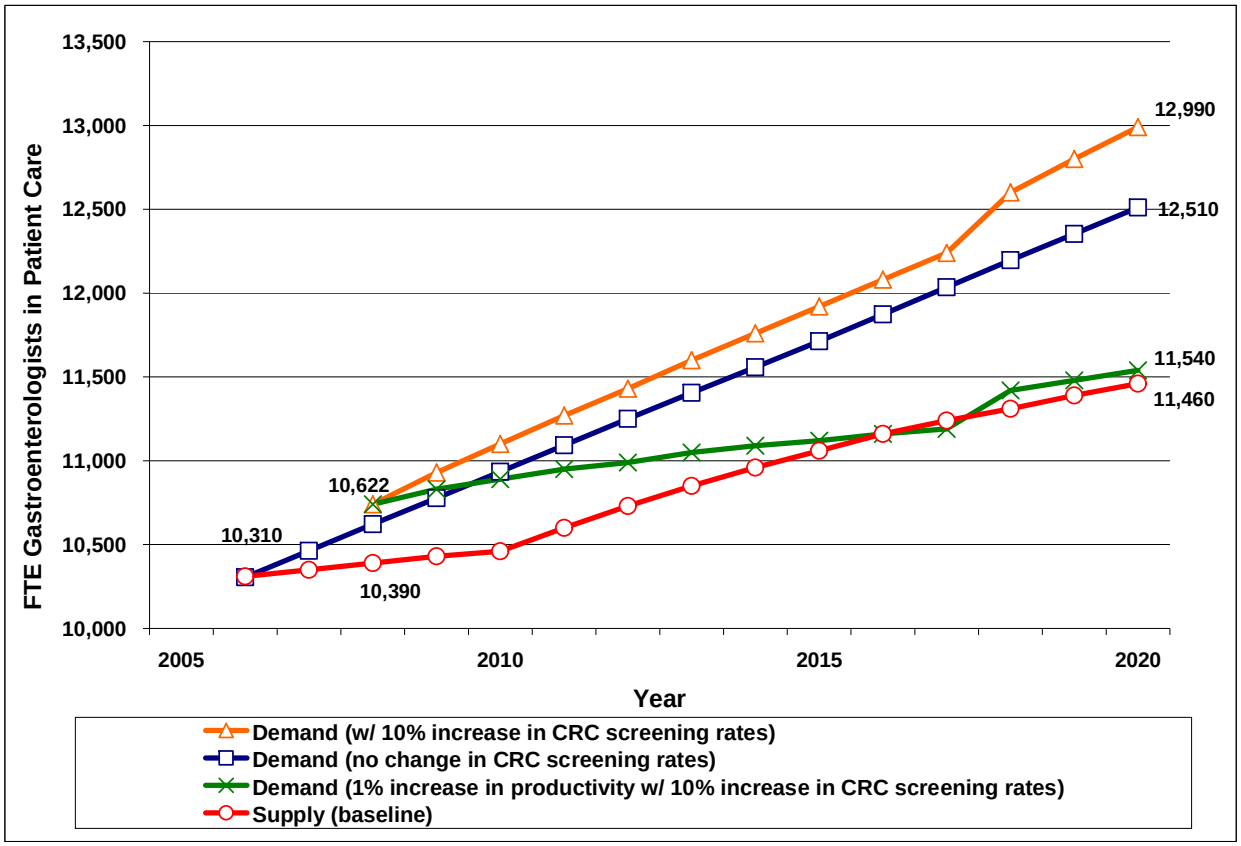
Source: Estimates from the PSDM. High growth scenario assumes 583 new gastroenterology fellows per year; baseline assumes 483 new fellows; and low growth assumes 383 new fellows.

The growth and aging of the U.S. population is causing demand for gastroenterologists to increase faster than supply. Between 2008 and 2020, FTE supply providing patient care is projected to grow by 10%, increasing by 1,070 physicians (Exhibit 15). Changing demographics will likely cause demand to grow by 1,890 FTE physicians (or 18%) during this period, with growth in demand estimated to be 2,370 (a 22% increase from 2008) if CRC screening rates rise by 10 percentage points.

Trends in gastroenterologist productivity have large implications for the future adequacy of gastroenterologist supply. The supply projections already take into consideration changes in work hours due to changing demographics of the physician workforce. There are multiple ways to measure physician productivity—one of which is relative value units (RVUs) that measure the intensity of services provided and are commonly used to determine level of reimbursement for physician services rendered. RVUs have three components: work (which measures amount of time and effort), practice expense (which measures equipment and supplies) and malpractice expense (which measures risk). Data from the 2001 through 2005 Medical Group Management Association Annual Survey[43] (which report data from 2000 through 2004) suggests that in the years immediately prior to 2002 both average total RVUs and average work RVUs per gastroenterologist were growing by several percent per year. Between 2002 and 2004, however, there is virtually no change in RVUs (average total RVUs actually declines from 16,675 in 2002 to 16,427 in 2004, while average work RVUs declines from 7,815 in 2002 to 7,791 in 2004).

Still, we model the potential impact on demand if gastroenterologists hypothetically were able to increase productivity by 1% annually (compounding to a 12.7% cumulative increase between 2008 and 2020), where productivity is defined in terms of the number of patients the typical physician can see each year. A compounding annual 1% increase in gastroenterologist productivity would, by 2020, have the same implications for adequacy of supply as training an additional 1,450 gastroenterologists. Productivity growth could come through a combination of greater use of physician assistants and nurse practitioners, improvements in technology that reduce time required to prepare for and perform surgical procedures, and increased use of electronic medical records that reduce the administrative burden on physicians.

Exhibit 15. Comparison of Baseline Gastroenterologist Supply to Alternate Demand Scenarios

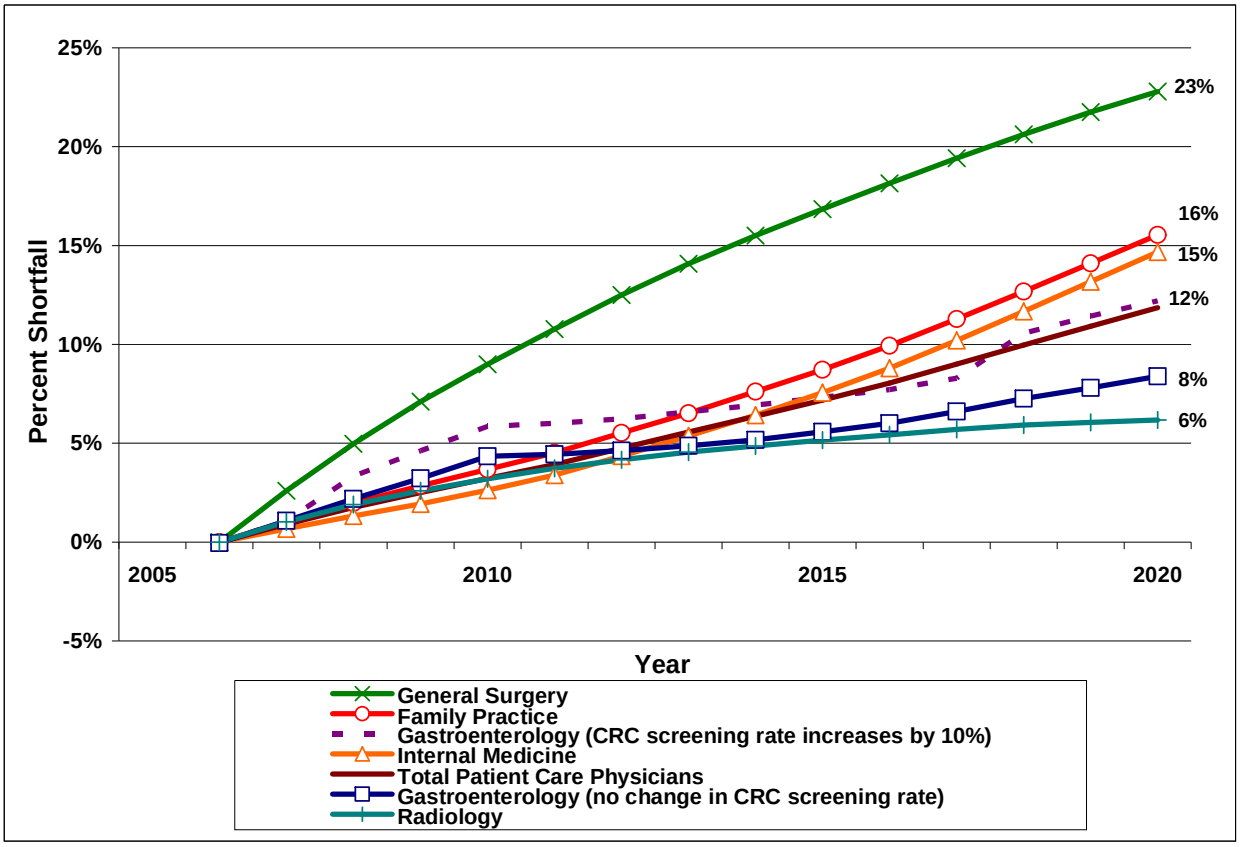


Source: Estimates from the PSDM.

Using the PSDM, we project the future supply of and demand for physicians in select specialties currently providing CRC screening: general surgery, internal medicine, family practice and radiologists. We assume that in the base year for the projections (i.e., 2006) national supply and demand are in balance—although there exist geographic imbalances in adequacy of supply. For example, the Health Resources and Services Administration estimates a current shortfall of 16,261 primary care practitioners (i.e., family practitioners, general internists, nurse practitioners, and physician assistants) in rural and underserved communities.[44]

For all four of these physician specialties, the growth and aging of the population is causing demand to grow faster than supply, such that by 2020 we project a 23% shortfall in general surgery, a 16% shortfall in family practice, a 15% shortfall in internal medicine, and a 6% shortfall in radiology (Exhibit 16). Overall, we project a 12% shortfall of physicians providing patient care. These shortfall projections suggest that non-gastroenterologist specialties will not be aggressive in expanding their scope of work to perform more colonoscopies.

Exhibit 16. Projected Percent Shortfall of Physicians, by Specialty



In addition to the overall projected shortfall of gastroenterologists, the gender and race/ethnicity distribution of gastroenterologists are much different than demographics of the patients being served. We calculated that approximately 10% of FTE gastroenterologists active in patient care are female, with this number projected to exceed 15% by 2020. An estimated 63% of gastroenterologist patient care time is spent providing care to female patients. Approximately 69% of gastroenterologists are non-Hispanic white; 2% are non-Hispanic black; 5% are Hispanic; 17% are Asian; and 6% are all other race categories.[38] Our analysis of health care utilization and delivery patterns suggests that approximately 69% of gastroenterologist patient care time is spent providing care to non-Hispanic whites (projected to decline to 64% by 2020); 13% is spent providing care to non-Hispanic blacks (increasing to 14% by 2020); 11% is spent providing care to Hispanics (increasing to 13% by 2020); and 7% is spent providing care to patients of other race (increasing to 9% by 2020).

V. Discussion

In summary, this study finds that the projected demand for gastroenterologists is growing at more than double the rate of supply. In fact, a shortfall of 1,050-1,550 gastroenterologists is likely by 2020 due primarily to growth in the size of the elderly population.

Actual demand could differ from the baseline projections, causing an even greater demand for gastroenterologists:

- Approximately 61% of the population age 50 and older is regularly screened for CRC, and CRC screening rates will likely continue to improve.
- Future changes in ability to treat gastrointestinal diseases could increase future demand for gastroenterologist services.

The following factors potentially decrease future demand:

- Emerging technologies such as computed tomographic colonography, DNA testing, and wireless capsules provide patients with an alternative to the traditional screening colonoscopy.
- Physicians in other specialties currently provide some colonoscopies; any efforts of these physicians to increase their share of colonoscopies performed would be offset by a decline in demand for gastroenterologist services.
- Rising gastroenterologist productivity could allow each gastroenterologist to care for a larger patient base.

Between 2008 and 2020, the supply of gastroenterologists is projected to grow by about 1,070 FTEs (10%), with the recent increase in annual number of physicians completing gastroenterology fellowships slightly exceeding the annual number of physicians retiring. If health care utilization and delivery patterns remained unchanged, during this same period demand would grow by an estimated 1,890 FTEs (18%)—due primarily to growth in size of the elderly population.

Changes in technology and an increased emphasis on age-risk appropriate CRC screening will cause health care utilization and delivery patterns to change over time. Using the *National Colorectal Screening Model*, we project that if national CRC screening guidelines were more fully implemented and the screening rate for the population age 50 and older rises from 61% to 71%, then demand for gastroenterologists would grow by approximately 2,370 FTEs (approximately 22%) between 2008 and 2020. The increase in the screening rate for CRC ultimately results in a reduction in CRC incidence due to polyp removal. However, this reduction in CRC incidence also leads to an increase in the size of the surveillance population. Based on the ACS guidelines, the surveillance population is likely to undergo colonoscopy every five years. Hence, an increase in CRC screening rates will lead to an increased demand for gastroenterologists.

Work by Seeff et al (2004) suggests that in 2002 there was a sufficient supply of colonoscopy services—physicians reported performing approximately 14.2 million colonoscopies with the capacity to perform an additional 8.2 million colonoscopies per year.[17] While the current supply of physicians might have the physical capacity to provide more colonoscopies, presumably the physician time required to provide additional colonoscopies would need to come from either increased hours worked or a reduction in time spent providing other patient services.

The projected growing shortfall of gastroenterologists could limit the nation's ability to implement national guidelines for CRC screening—with the shortfall exacerbating access barriers in geographic areas characterized by chronic inadequacies in physician supply. To be able to meet the projected increase in demand from a growing elderly population and anticipated increases in CRC screening, in the absence of productivity growth the number of new adult gastroenterology fellows completing training each year would need to increase by one third (to approximately 546).

Rising gastroenterologist productivity would help to reduce this projected shortfall. If gastroenterologist productivity (defined by the size of the population supported by each gastroenterologist) increased by as little as 1% annually, between 2008 and 2020 the cumulative increase in productivity would be 12.7%. This increase by 2020 would be equivalent to increasing the supply of gastroenterologists by 12.7% (or approximately 1,450 FTE gastroenterologists). Productivity increases are achievable through a combination of greater use of physician assistants and nurse practitioners, improvements in technology that reduce time required to prepare for and perform surgical procedures, and increased use of electronic medical records that reduce the administrative burden on physicians. However, in recent years there is little indication of increases in gastroenterologist productivity as measured by total RVUs or by work RVUs.

The main contribution of this study is that it provides a glimpse at the nation's ability to more fully implement national guidelines regarding the frequency of CRC screening—given a projected growing shortfall of gastroenterologists. The study uses two simulation models, the *National Colorectal Screening Model* and the *Physician Supply and Demand Model*, to estimate the implications of changes in CRC screening rates and modality on demand for gastroenterologists, and to simulate future gastroenterologist supply and demand under alternate scenarios. These models are simple representations of a complex health care system that try to capture the major trends in technology, changing demographics, number of gastroenterologists being trained, and patterns of health care use and delivery.

Uncertainties that can impact projections of adequacy of gastroenterologist supply and study limitations include the following:

- Uncertainty regarding the adoption of new technology: The rate at which CTC, DNA testing, wireless capsules, and technologies yet to be discovered supplement and/or replace other types of CRC screening will be influenced by continued improvements in technology, changes in reimbursement policies, and the preferences of patients and clinicians. In this study we assume a modest increase in use of CTC. We assume that sigmoidoscopy will be phased out. Additional technologies with workforce implications are improvements in equipment and greater use of electronic medical records—factors that can improve gastroenterologist productivity.
- Uncertainty regarding increased use of physician assistants and nurse practitioners: The use of physician extenders within gastroenterology has risen over the past decade. Unknown is the extent to which gastroenterologists can continue to increase use of extenders and the implications for gastroenterologist productivity.
- Uncertainty regarding changing scope of physician practice and practice models: The degree to which physicians in specialties other than gastroenterology will perform CRC screenings is uncertain. The degree to which general internists, family physicians, general surgeons, colorectal surgeons, radiologists, and physicians in other specialties

perform colonoscopies in the future can affect demand for gastroenterologists and the nation's ability to supply CRC screenings. Our work suggests that the above specialties are facing a growing shortage of physicians, which will limit their ability to provide colonoscopies. Changing models of care in which the primary care physician plays a greater role in cancer screening and prevention could impact the proportion of colonoscopies performed by family physicians.

- Uncertainty regarding physician workforce patterns: The projections of future physician supply assume that patterns in hours worked and retirement remain relatively unchanged over time—controlling for physician demographics. Anecdotal evidence suggests that younger physicians are seeking a greater work-life balance and are interested in working fewer hours than older cohorts of physicians. Also, our analysis of the AAMC survey of physicians over age 50 suggests that physicians would like to retire earlier than historical retirement patterns suggest. If younger cohorts of physicians work shorter hours or retire earlier, then shortfall projections might be understated.

Uncertainty regarding trends in CRC screening and technology, and trends in determinants of gastroenterologist supply and demand highlight the importance of periodically updating these supply and demand projections.

Improving rates of CRC screening requires that the public be educated on the health benefits of appropriate screening and be motivated to be screened, and that people have access to screening. Study implications are that the nation's ability to increase CRC screening rates will be hampered by a projected growing shortfall of gastroenterologists and other physicians. Increasing the number of fellows trained can help reduce the shortfall. Ensuring an adequate supply of gastroenterologists will help ensure timely access to high quality CRC screening services—which can save lives and improve quality of life.

VI. Appendix

Additional Tests or Cases	Age Group	Table A.1. Statistics for Scenario of Increasing Screening Rate Only (10% increase in CRC screening rate)												
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
FOBT	All	248,819	396,474	485,609	530,475	547,817	549,626	542,963	529,333	507,301	483,455	461,363	443,018	429,859
FIT	All	27,647	66,336	109,338	150,954	189,246	224,103	255,901	283,744	305,304	323,195	339,548	356,205	375,085
Sigmoidoscopy	All	23,223	16,761	11,519	5,750	0	0	0	0	0	0	0	0	0
CT colonography	All	0	0	0	0	0	0	0	0	0	0	0	0	0
Screening colonoscopy	All	231,125	262,585	276,461	281,739	287,296	287,721	288,960	287,176	277,663	272,829	465,241	508,309	537,664
Diagnostic colonoscopy	All	48,041	76,313	96,722	109,792	118,098	124,382	128,818	131,510	131,843	131,276	130,744	130,785	132,001
Colonoscopy	All	279,166	338,898	373,183	391,531	405,395	437,664	447,826	452,063	444,521	440,760	826,893	911,037	963,704
Polyps	All	28,144	33,273	37,055	39,086	40,969	41,910	42,884	43,367	42,908	42,867	63,491	68,221	72,113
Stage I	All	112	138	155	165	172	201	208	214	217	220	439	489	525
Stage II	All	79	97	108	114	117	135	139	142	142	142	227	247	261
Stage III	All	44	53	59	62	64	74	76	78	78	78	123	133	141
FOBT	45-64	248,819	396,474	485,609	530,475	547,817	549,626	542,963	529,333	507,301	483,455	461,363	443,018	429,859
	65-74	10,895	18,956	24,484	28,430	32,264	34,978	36,485	37,427	37,784	37,926	37,912	37,876	37,956
	75+	1,159	2,768	3,932	4,739	5,286	5,637	5,866	6,001	6,178	6,405	6,529	6,551	6,557
FIT	45-64	27,647	66,336	109,338	150,954	189,246	224,103	255,901	283,744	305,304	323,195	339,548	356,205	375,085
	65-74	1,211	3,172	5,513	8,090	11,146	14,262	17,196	20,062	22,739	25,354	27,902	30,454	33,119
	75+	129	463	885	1,349	1,826	2,298	2,765	3,217	3,718	4,282	4,805	5,267	5,721
Sigmoidoscopy	45-64	23,223	16,761	11,519	5,750	0	0	0	0	0	0	0	0	0
	65-74	1,017	751	509	262	0	0	0	0	0	0	0	0	0
	75+	108	116	78	40	0	0	0	0	0	0	0	0	0
CT colonography	45-64	0	0	0	0	0	0	0	0	0	0	0	0	0
	65-74	0	0	0	0	0	0	0	0	0	0	0	0	0
	75+	0	0	0	0	0	0	0	0	0	0	0	0	0
Colonoscopy	45-64	279,166	338,898	373,183	391,531	405,395	437,664	447,826	452,063	444,521	440,760	826,893	911,037	963,704
	65-74	12,275	15,486	17,184	18,857	21,268	26,672	28,813	30,621	32,245	33,749	117,905	140,780	155,656
	75+	1,307	2,364	2,681	2,959	3,194	4,128	4,580	4,861	5,214	5,643	26,376	32,512	35,892
Screening colonoscopy	45-64	231,125	262,585	276,461	281,739	287,296	287,721	288,960	287,176	277,663	272,829	465,241	508,309	537,664
	65-74	10,120	11,759	12,208	12,838	14,141	15,057	15,514	16,054	16,567	17,063	58,946	70,253	77,589
	75+	1,077	1,817	1,881	1,955	2,024	2,071	2,135	2,196	2,301	2,453	12,755	15,754	17,367
Diagnostic colonoscopy	45-64	48,041	76,313	96,722	109,792	118,098	124,382	128,818	131,510	131,843	131,276	130,744	130,785	132,001
	65-74	2,155	3,727	4,976	6,019	7,127	8,136	8,914	9,594	10,145	10,650	11,143	11,616	12,124
	75+	230	547	800	1,004	1,170	1,314	1,437	1,542	1,662	1,803	1,929	2,021	2,107
Polyps	45-64	28,144	33,273	37,055	39,086	40,969	41,910	42,884	43,367	42,908	42,867	63,491	68,221	72,113
	65-74	1,893	2,364	2,628	2,902	3,288	3,631	3,868	4,113	4,330	4,531	11,143	13,014	14,259
	75+	200	363	412	458	498	534	571	604	648	702	2,344	2,839	3,112
Additional minutes/year (x1,000)	45-64	16,906	20,550	22,665	23,789	24,622	26,533	27,156	27,421	26,979	26,756	49,287	54,200	57,292
	65-74	751	950	1,057	1,161	1,310	1,631	1,762	1,873	1,973	2,065	7,004	8,349	9,225
	75+	80	145	165	183	197	252	280	297	319	345	1,562	1,922	2,121
Additional FTE Gastroenterologists		**123**	**150**	**166**	**175**	**181**	**197**	**203**	**205**	**203**	**203**	**402**	**448**	**477**

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