



Trends in Adenoma Detection Rates During the First 10 Years of the German Screening Colonoscopy Program

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BACKGROUND & AIMS: The adenoma detection rate (ADR) is an important quality indicator of screening colonoscopy; it is inversely associated with risk of interval cancers and colorectal cancer mortality. We assessed trends in the ADR in the first 10 years of the German screening colonoscopy program. **METHODS:** We calculated age-adjusted and age-specific detection rates of nonadvanced adenomas and advanced adenomas for each calendar year based on 4.4 million screening colonoscopies conducted from 2003 through 2012 and reported to the German screening colonoscopy registry. **RESULTS:** We observed a steady and strong increase in rate of detection of nonadvanced adenomas in both sexes and all age groups. Age-adjusted rates of detection of nonadvanced adenomas increased from 13.3% to 22.3% among men and from 8.4% to 14.9% among women. This increase was mostly due to an increase in detection rates of adenomas <0.5 cm, and it is partly explained by an innovation effect (higher ADRs among incoming colonoscopists than among leaving colonoscopists, and relatively stable ADRs among continuing colonoscopists). Only modest increases were observed in detection rates of advanced adenomas (from 7.4% to 9.0% among men, and from 4.4% to 5.2% among women) and colorectal cancer. In 2012, overall ADR reached 31.3% and 20.1% in men and women, respectively. **CONCLUSIONS:** We observed a strong increase in ADRs from 2003 through 2012 in Germany. Although we cannot exclude the effects of secular trends in colorectal neoplasm prevalence, the observed increase was mainly the result of a steady increase in detection of nonadvanced adenomas (especially adenomas <0.5 cm). Further research should address potential implications for defining screening and surveillance intervals.

Keywords: Colon Cancer; Endoscopy; Colorectal Neoplasms; Prevention.

There is increasing evidence that screening colonoscopy with detection and removal of adenomas is a powerful approach to colorectal cancer (CRC) prevention.^{1–5} Effectiveness of CRC prevention obviously depends on the ability of colonoscopists to detect and remove colorectal adenomas, and the adenoma detection rate (ADR), which is

related to the level of training,⁶ has been suggested to be an important and necessary, albeit not sufficient, indicator of endoscopist performance.^{7,8} Recent studies have demonstrated the ADR at screening colonoscopy to show clear inverse associations with the risk of interval cancers⁹ and CRC mortality.¹⁰

ADRs are known to vary by sex and age of patients.^{9,11–14} However, previous studies have demonstrated strong inter-physician variation and inter-center variation in the ADR, even after adjustment for patient factors.^{9,15} To our knowledge, however, no previous study has systematically assessed time trends in ADR on the national level in countries offering screening colonoscopy. In this article, we provide a detailed assessment of such trends according to sex and age of screening colonoscopy participants within the initial 10 years of the German screening colonoscopy program.

Methods

Database

Our analysis is based on data of the German screening colonoscopy registry.¹⁴ Screening colonoscopy has been offered in Germany as a primary screening examination for early detection and prevention of CRC since October 2002. Women and men aged 55 years or older are eligible for a first screening colonoscopy. If this first screening colonoscopy is conducted before 65 years of age, a second screening colonoscopy is offered 10 years later. Certification to conduct screening colonoscopy is tightly regulated on the basis of extensive previous training and experience, and its maintenance is subject to rigorous quality control. In particular, only gastroenterologists, internists, or surgeons who have conducted at least 200 colonoscopies in the preceding 2 years are certified for conducting screening colonoscopies. Maintenance of certification is contingent on conduction of at least 200 colonoscopies per year, the quality and completeness (ie, terminal ileum reached) of which has to be proven by photo or video documentation. These requirements, which do not include a minimum

Abbreviations used in this paper: ADR, adenoma detection rate; CRC, colorectal cancer.

ADR limit, did not change over time during the period of investigation. Histopathologic examination is performed decentrally by certified pathology laboratories.

Along with introduction of screening colonoscopy, a national screening colonoscopy registry was built up, including all screening colonoscopies among men and women covered by Statutory Health Insurance (close to 90% of adults in the eligible age range). Details of the registry's operation and data quality have been reported elsewhere.^{14,16} Briefly, all screening colonoscopies are reported anonymously on a standardized form. Reporting is virtually complete, as it is a prerequisite for physicians' reimbursement by the health insurance funds. The registry includes primary screening examinations only (ie, it does not include colonoscopies conducted for surveillance, workup of symptoms, or other screening tests). Items reported include basic sociodemographic variables, as well as information on findings at colonoscopy, including number (categories: 1, 2–4, and >4), size (categories: <0.5, 0.5–1 cm, 1–2 cm, and >2 cm), and histologic characteristics of polyps. In case of multiple neoplasms, only characteristics of the most advanced type are recorded. The reporting forms are processed and checked for completeness and plausibility using standardized algorithms at regional data centers before anonymized transfer to the national data center. Approximately 20%–30% of eligible people have had a screening colonoscopy within the initial 10 years from the introduction of this screening offer. For this analysis, we used data from 4,407,971 first-time screening colonoscopies in 2003–2012.

Statistical Analyses

Given the strong differences in adenoma prevalences between men and women, all analyses were conducted separately for men and for women. In addition, given expected differences in detection rates of advanced and nonadvanced adenomas, analyses were conducted separately for both types of adenomas. In the German screening colonoscopy registry, advanced adenomas are defined as at least 1 adenoma ≥ 1 cm or at least 1 adenoma with villous components or high-grade dysplasia. In additional analyses, adenoma detection rates were stratified by adenoma size, regardless of histologic subtype (<0.5 cm, 0.5–1 cm, and >1 cm).

We first present trends in cumulative numbers of participants in screening colonoscopy up to various ages (60, 65, 70, 75 years, and any age) for each calendar year from 2002 to 2012. Apart from the trends in numbers of participants, these results also indicate changes in age distribution of screening colonoscopy participants over time, which requires careful consideration in the analysis of trends in ADR, due to the dependency of adenoma prevalences on age.

We then present age-adjusted and age-specific detection rates of the various types of colorectal adenomas for each calendar year from 2003 to 2012. Age adjustment was done to the age distribution of screening colonoscopy participants in the total study period (2003–2012). In order to make results comparable between men and women, the same standard population of all 4,407,971 screening colonoscopy participants included in this analysis was used for age adjustment in analyses for both men and women. Age categories used for adjustment and for age-specific analyses were 55–59, 60–64, 65–69, 70–74, 75–79 and 80+ years. For comparison, age-adjusted detection rates are also shown for colorectal cancer,

and detection rates are also shown for all neoplasms combined. For clarity of presentation and due to their very small size, we did not include 95% confidence intervals in the graphical presentations of ADRs. Given the very large size of the study population, the width of the confidence intervals was <1%-unit even for the vast majority (173 of 240 [72%]) of the sex-, age-, and calendar-year-specific detection rates of nonadvanced and advanced adenomas, the exceptions were mostly restricted to age groups 75–79 years and 80+ years.

In order to address possible reasons for, and consequences of, trends in ADR, we also assessed trends in age-adjusted cecal intubation rates and in sedation rates, as well as in age-adjusted bleeding and perforation rates for both men and women over time.

The composition and technical equipment of colonoscopists are not constant over time and observed trends in ADR might partly reflect an "innovation effect." To assess the potential role of such an innovation effect, we carried out additional separate analyses for "incoming" colonoscopists (typically younger colonoscopists opening or joining a gastroenterology practice with the most recent technological equipment) and "leaving" colonoscopists (typically older, retiring colonoscopists), as well for "continuously practicing" colonoscopists providing screening colonoscopies throughout the period of investigation. Because unique colonoscopist identifiers were only included in the database from 2008 on, these analyses were restricted to calendar years 2008–2012. Also, the database does not include colonoscopists' age, so the impact of this variable could not be assessed directly. Incoming colonoscopists were defined as colonoscopists not providing any screening colonoscopy in 2008, but providing screening colonoscopies in 2012 and possibly preceding years. Leaving colonoscopists were defined as colonoscopists providing screening colonoscopies in 2008 and possibly subsequent calendar years, but not in 2012. Continuously practicing colonoscopists were defined as colonoscopists providing screening colonoscopies in each calendar year from 2008 to 2012. Age-adjusted, sex-specific detection rates of nonadvanced adenomas and advanced adenomas were calculated for each calendar year and each group.

Finally, in order to assess stability of variation and ranking of overall ADR across colonoscopists over time, we assessed the joint classification of continuously practicing colonoscopists according to sex- and age-adjusted quintiles of overall ADR in 2008 and 2012. In order to limit the role of random variation, this analysis was restricted to colonoscopists who performed at least 50 screening colonoscopies among women and 50 screening colonoscopies among men in each of the 2 calendar years. For this analysis, indirect adjustment by sex and age was performed, using overall sex- and age-specific ADR in 2008 and 2012 to calculate expected ADRs. Agreement of ADR quintile in 2008 and 2012 beyond chance was quantified by a quadratically weighted κ coefficient with weights of 1, 4, 9, and 16 for differences by 1, 2, 3, and 4 quintiles, respectively.

Results

Figure 1 shows the annual cumulative numbers of men and women participating in screening colonoscopy up to various ages. Among men, the total number of screening colonoscopies increased steeply between 2003 and 2004 and reached its peak at 239,970 in 2006. Since then,

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