

## **Associations between county-level surgeon density and colorectal cancer (CRC) mortality.**

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Abstract Text:

**Background:** Strong associations between surgical procedure volumes and patient outcomes have been consistently observed for many types of cancers. Whether surgeon density in a population has a similar impact on cancer outcomes is unclear. Our aims were to 1) explore the effect of US county-level surgeon density on CRC mortality and on annual changes in death, 2) compare the relative importance of colorectal surgeon (CS) versus general surgeon (GS) density on these CRC outcomes and 3) identify other county characteristics associated with decreased mortality.

**Methods:** Using county-level data from the Area Resource File, US Census and National Cancer Institute, we developed multivariate regression models to determine the effect of a) CS and b) GS on overall CRC mortality as well as on changes in death between 2002 and 2006, while controlling for CRC incidence, county demographics and other socioeconomic factors.

**Results:** A total of 1,767 US counties were included: mean CRC incidence and death rates were 64.9 and 19.9 per 100,000 people; 45% were metropolitan and 55% were rural counties; mean CS and GS densities were 1.3 and 4.1 per 100,000 people, respectively. When compared to counties with no CS and no GS, those with at least of one of these surgeons had a statistically significant decrease in CRC-specific mortality (beta coefficients -0.35 and -0.2 for CS and GS, respectively;  $p=0.014$ ). Increasing the county-level density of surgeons improved outcomes, but increasing it beyond 6 CS or 14 GS per 100,000 people did not continue to result in significant reductions in CRC mortality. Similar associations between surgeon density and annual changes in CRC-related death were observed. Counties with a high proportion of Medicare enrollees also showed increased CRC mortality.

**Conclusions:** The presence of CS and GS at the county level is each associated with lower mortality from CRC. However, there appears to be a ceiling effect at which point further increases in their density do not produce continued improvements in CRC outcomes. A balanced strategy of allocating healthcare resources and distributing the surgical workforce evenly across all counties will likely offer the most substantial population-based improvements in CRC mortality.