Exploring the Impact of Medicaid Expansion on Colorectal Cancer (CRC) with a Focus on Individuals Below the Standard Screening Age in the United States

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Abstract

In the United States, the second most common cause of cancer death is colorectal cancer (CRC). While it is imperative that there are viable insurance options to get preventive tests, many states have opted not to participate in the Medicaid expansion, thus adding to health care discrepancies and disparities among CRC patients. The typical U.S. CRC screening age is 50 years old, but due to a rising incidence rate of CRC in younger individuals this standard is now being challenged. We used the Surveillance, Epidemiology, and End Results (SEER) program research data (1975-2017) from the National Cancer Institute (NCI) to conduct a secondary data analysis on CRC participants from a cancer registry based on geography, health insurance access, age, race, and stage of diagnosis. The resulting data analysis for 13 U.S. states (12 Medicaid expansion and one non-expansion) did not yield any association between race and CRC incidence across the provided age groupings. There was, however, a statistically significant association between age group and stage of diagnosis. The highest CRC mortality rates were also found in the southeastern U.S., where the largest proportion of non-expanded states are located. These findings demonstrate a need to lower the CRC screening age to cater to the increase in younger individuals developing this disease, as well as expand the benefits stemming from Medicaid expansion, both of which would ultimately reduce potential CRC disparities and poor health outcomes.

Introduction

Colorectal cancer (CRC) remains the second leading cause of cancer-related death in the United States due to rising cases in adults under the age 50 (1). The negative correlation between CRC screening and mortality rates in individuals over the age of 50 years has increased; however, the same cannot be said for those below the screening age (1).

Some individuals may fall within a coverage gap if they earn above their state's eligibility for Medicaid, but below the minimum income required to afford private insurance. This jeopardizes their well-being because they are left without a viable option for obtaining necessary preventive health care. Medicaid expansion may provide a safety net for these low-income individuals, but only in the states that have opted for its implementation. In order to better understand the impact of Medicaid expansion on CRC, this study examined the incidence and mortality rates with a special focus on individuals below the standard screening age.

Despite positive outcomes from screening and diagnostic tests, the U.S. continues to face socioeconomic disparities with CRC incidences. From an economic standpoint, financial barriers have continued to hinder individuals from receiving the necessary CRC screenings (2). It is hypothesized that the unfavorable diagnoses and prognoses of the CRC patients facing these current disparities will be further exacerbated in non-expanded Medicaid states compared to expanded states.

Most CRC patients tend to suffer from the disease for quite some time before they are diagnosed due to the "delayed" requirements for CRC screenings starting at ages 50 years and older (3). Individuals below 50 were not originally thought to be at substantial risk for CRC; however, there has been a rise in CRC cases among younger adults once thought to be less prone to the disease (3).

Although the incidence of CRC is decreasing for the standard age group, the incidence in those younger than 50 has been increasing by 2.0% annually for the last 9 years (4). These findings make it imperative that younger adults below the screening age of 45 to 50 have a viable insurance option in order to receive these preventive measures, especially if they are deemed to be at a higher risk (5). Moreover, for those young adults with insurance and access to primary care physicians, there are still issues with the recognition of this disease. Of the 1,195 CRC patients and survivors ages 20 to 49 surveyed by researchers in 2018 (mostly in the U.S.), 57% were diagnosed between ages 40 and 49, 33% were diagnosed between 30 and 39, and 10% were diagnosed before age 30 (6). Thus, not only is this younger population more likely to be uninsured and less likely to be screened, but their symptoms are more frequently overlooked by their physicians and themselves.

It is no longer safe to assume that only those with a family history of cancer are at risk, as a new group with early onset CRC (EOCRCs) and no family history of the disease has recently emerged (3). These are all patients who were diagnosed under the current recommended screening age of 50 (3). The current diagnostic guidelines were established based on familial cancer and are typically insufficient for early onset diagnosis (3).

The importance of this CRC-focused research is reflected in its novelty of investigating the impact of Medicaid expansion on the CRC incidences among the younger individuals as opposed to the typically studied older individuals. If individuals develop CRC at a younger age but lack viable options for diagnosis and treatment, then this will result in increased incidence and mortality rates over time (7). This study aimed to provide

vital information about incidences and diagnoses, as well as background analysis on at-risk individuals by examining the collected CRC data from Medicaid expanded and non-expanded states.

Methods

Procedures

Surveillance, Epidemiology, and End Results (SEER) is a cancer registry database including information acquired by the North American Association of Central Cancer Registries' (NAACCR) Data Standards on patient demographics (age, sex, and race), cancer characteristics, stage of disease, treatment, and outcomes (8,9). This study was a secondary data analysis using the SEER cancer registry data — evaluating states from each region throughout the country — and addressed any CRC-related discrepancies in the region based on several variables. The categorical variables included within this analysis were health insurance access, race, and sex, and the continuous variable was age of diagnosis. These variables were analyzed in order to describe any associations between them, as well as to isolate certain descriptive characteristics (e.g., age range). All the data in this paper was obtained from electronic records (SEER) and stored on password-protected electronic devices. The medium for data storage was a Microsoft Excel file with exclusive access to current members of the research group. No physical data with sensitive or identifiable information was used for this research. This systematic investigation utilized a broad range of measured demographic, functional, and health variables. It sought to interpret and inform generalizable knowledge, with protection of vulnerable groups, minimized risk to all participants, and it did not include any sensitive information. This study was reviewed by Geisinger's Institutional Review Board and determined not to be human subjects research under the federal Common Rule, 45 CFR Part 46.102(d).

The SEER program is used by the National Cancer Institute (NCI), which is a source of cancer-related statistical information (9). Specifically, the information relates to cancer incidence rates and survival data/mortality rates based upon cancer registries accounting for approximately 35% of the U.S. population (10). These reported cases are then reviewed to determine if the provided information should be stored in the cancer registry respective to each state (8). If so, the cancer registries then obtained the necessary cancer-related information from the patient's medical records (8).

A cancer registry can be either population-based or hospital-based; the SEER program utilizes the population-based registry model for collecting the necessary cancer statistics (10). The overall design of this type of registry is meant to gather information to monitor the distribution of cancer among various demographic factors which provide a basis that can be used for future efforts in research and determining effective use of health resources currently available in cancer control efforts (10). The requested information from the SEER 1975–2017 Research Data was utilized when conducting the secondary data analysis (11).

Participants

The SEER program data for this study contains information collected from cancer registries that have analyzed participants' clinical data, demographic, and mortality rates associated with CRC, as well as their health insurance status (12). This primary data source provides a succinct population-based resource which was utilized in this study to analyze the impact of Medicaid on CRC screening and diagnosis. The SEER program contains CRC incidences of a population categorized by age, race, sex, and geographic location. This secondary research data considered the following variables: age of diagnosis, access to health insurance, race, and sex in various states. This sample size included participants from all races and sexes, within the specified age range of 20 to 64 years old. Specifically, the SEER program has age groups listed in 5-year increments starting at age 0 to 85+; however, the age range for this study started at 20 years and ended inclusively at 64 years of age. The selected lower limit of 20 corresponded to the earliest adult age group reflected in the primary source data. An upper age limit of 64 was selected because individuals age 65 and older are covered under Medicare and thus fell outside the scope of this study. Despite these exclusions, the sample size was large enough to allow for effective statistical analysis.

All 13 of the states included in the SEER database for CRC incidence rates were included in this analysis. The SEER Registry makes it voluntary for individual states to include their cancer information in the database, hence only 13 states have data available for public use; all 13 states were included for this analysis to maximize the available data (13). Together, the chosen states represent the different regions of the U.S. (i.e., the Northeast, Mid-Atlantic, Southeast, Midwest, Southwest, Northwest, and West). Hawaii and Alaska were also included in this analysis, although their data in the SEER database was very limited.

Statistical analysis

We performed descriptive analyses including age range, count (e.g., sample size), and percent (e.g., CRC incidence sex and race breakdown within each state). We also conducted an inferential analysis, calculating a p-value from each chi-square test, and weighted the samples for all analyses used via SEER*Stat Software (14). The samples were weighted in order to reduce survey bias and adjust for unequal selection probabilities (15).

Multiple chi-square tests were implemented on the data: the first included age of CRC diagnosis versus access to health care, to determine if access to health care had any relation to age of diagnosis. More specifically, it sought to ascertain if living in a Medicaid expansion state was associated with a difference in diagnosis age. The second chi-square test compared age of diagnosis versus race, to ascertain if there was any relationship between race demographic and age of CRC diagnosis. A third chi-square test evaluated the stage at which the CRC was diagnosed (localized or regional) versus the specified age ranges. The 5-year age ranges provided by SEER were collapsed into 15-year increments, and 2x2 chi-square tests were utilized to investigate any associations. The chi-square tests compared the 20–34 age group versus the 50–64 age group, as well

as the 35–49 age group versus the 50–64 age group. No association was pursued between the 20–34 and 35–49 age groups, since these both fell below the common threshold for CRC screening in most states. This data analysis used the chi-square test in particular to evaluate statistical independence or association between two categorical variables within each state, whereupon it compared the findings from each state. The "age" variable was actually an age range, which is considered a categorical variable and appropriate for this type of test. The results of the chi-square tests are presented as a figure, in the form of a distribution curve. For the p-values obtained, values above 0.05 show that the data is statistically non-significant (although the indicated association may still be noteworthy) (16). Heat maps were used to delineate CRC adjusted mortality data by state for ages 20 to 64 from both 2010–2013 and 2015–2018. The heat map software used was provided by Microsoft Excel. These analyses could provide evidence supporting lowering the initial screening age for CRC in the U.S.

Results

Mortality rates

Due to states expanding at different times, four years pre- and post-initial Medicaid expansion were observed to provide a balanced range to account for varying mortality rates among the states. In 2010, the mortality rates ranged from 10 to 12 deaths per 100,000 in the population in the Northeast, Mid-Atlantic and Southeast region. The western regions' mortality rates were predominantly less than 10 with a few exceptions, including Colorado and Nevada. In the Southeast region, Mississippi had the highest mortality rate, with 13.63 deaths per 100,000 in the population (Figure 1). The mortality rates in 2011 closely paralleled those in the previous year, with Mississippi remaining the state with the highest mortality rate of 14.01 deaths per 100,000 (Figure 2). In 2012, Arkansas and Mississippi had the highest mortality rates in the country at 14.73 and 14.71 per 100,000 in the population, respectively. A majority of the country had mortality rates below 10 or nearly 10. States with mortality rates equal to or greater than 10 were on the eastern side of the country (Figure 3). By contrast, in 2013 nearly all of the states in the country had a mortality rate of 6 to 12 per 100,000 in the population. Northeast, Mid-Atlantic and Southeast states had rates that were equal to or greater than 10 per 100,000. On the opposite side of the country, mortality rates in the western U.S. states were predominantly less than 10, with the exception of Nevada having a mortality of 10.54 per 100,000. Mississippi had the highest mortality rate, with 13.74 per 100,000 in the population (Figure 4).

With Medicaid expansion taking place in 2014, there was an expected year or two delay before any notable trends could be exhibited throughout the country. In 2015, the mortality rates mirrored similarly to those in 2013, with the eastern half of the country having higher mortality rates than the western half. Nevada had the highest rate in the West, with 10.04 deaths per 100,000 in the population, and Mississippi had the highest mortality rate in the country, with 13.54 deaths per 100,000 in the population (Figure 5). Two years following the expansion, higher mortality rates were concentrated in the Southeast region, with Mississippi having the highest at 14.35 deaths per 100,000 (Figure 6). A similar trend was found in 2017, with the Southeast having the greatest mortality rates of the entire country. Mississippi, Arkansas and Louisiana rates were 13.38, 13.53, and 13.39 deaths per 100,000 in the population, respectively. Nevada had the highest mortality rate in the West, with 10.43 deaths per 100,000 (Figure 7). In 2018, the mortality rates increased within the Southeast region and the Mid-Atlantic region. Mississippi had the highest, with 13.54 deaths per 100,000, and West Virginia had 13.48 deaths per 100,000 in the population (Figure 8).

Chi-square tests

In our comparison between race and the youngest age group versus the oldest age group, California, Iowa and Louisiana demonstrated a relationship between the two extreme age cohorts and race in terms of CRC incidence rates in the year 2014 (Table 1). During 2015, the combined incidence rates of Alaska and Hawaii exhibited a relationship between race and age cohorts.

For our comparisons between race and the middle-age group versus the oldest age group, there was no relationship between them in terms of CRC incidence rates. Washington in 2015 was the only state that demonstrated a significant relationship between race and age influencing CRC incidence rates (Table 2).

When the race and insurance of CRC-diagnosed individuals was examined, there was no relationship between the race of a patient and their insurance status for expanded states. However, in Georgia, the single non-expanded state, there was a relationship between race and insurance status for CRC diagnosis of patients (Table 3).

In our comparison between age and the stage upon which CRC was detected, there was a suggested relationship between the youngest age group (20–34) experiencing statistically significant instances and advanced stages of CRC that had originally been exclusive to the older age group (Table 4). Additionally, we identified a significant relationship between the middle age group and more advanced stages of CRC at the time of diagnosis compared to the older age group (Table 4).

Discussion

From observations made of the heat maps 4 years prior and post-Medicaid expansion, the Southeast region had the highest mortality rates before and after the expansion of the 7 regions. It must be noted that the majority of non-expanded states are located in this region, including Mississippi, Alabama, Florida, and Georgia. By contrast, the West, Mid-Atlantic, and Northeast regions of the country with predominantly expanded states have post-expansion mortality rates that are steady or slightly decreased from pre-expansion rates. This suggests that the adoption of Medicaid expansion may have a beneficial effect on the diagnosis and treatment of CRC. Compared to expanded states, the mortality rates of non-expanded states rose steadily (by 1 to 2 points) during the post-expansion years. However, there were some expanded states with mortality rates that continued to rise by a few points during the post-expansion years (2015–2018). This rise in mortality rates in expanded states called for acknowledging additional factors unique to each state having an impact on the overall CRC mortality rate of patients 20 to 64. Some of the possible reasons for this

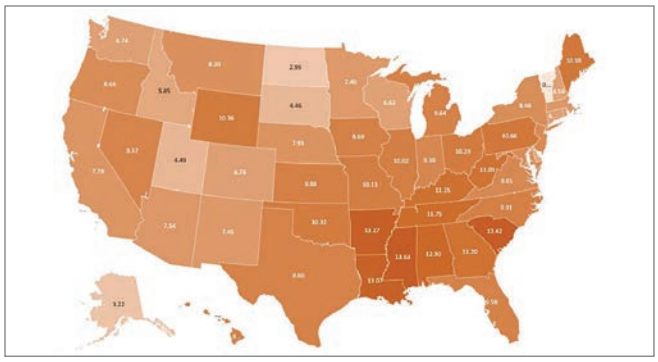

Figure 1. Age-adjusted per 100,000 CRC mortality rate for adults 20–64 in 2010. Darker colors reflect increased mortality.

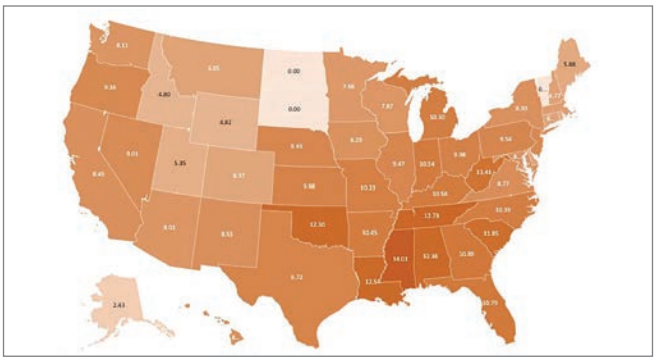

Figure 2. Age-adjusted per 100,000 CRC mortality rate for adults 20–64 in 2011. Darker colors reflect increased mortality.

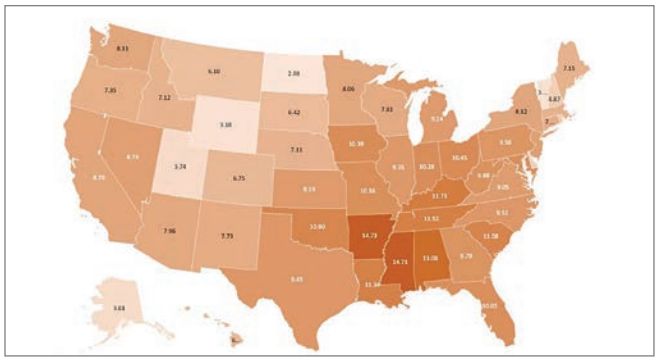

Figure 3. Age-adjusted per 100,000 CRC mortality rate for adults 20–64 in 2012. Darker colors reflect increased mortality.

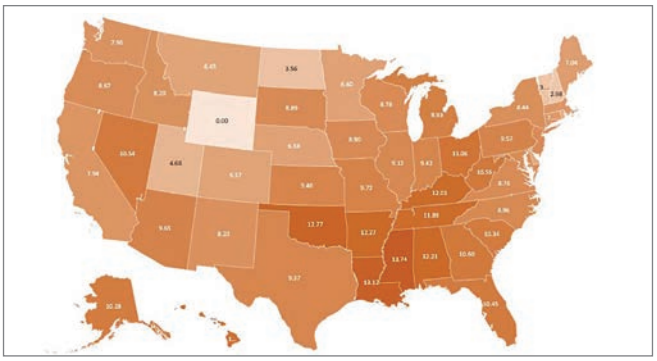

Figure 4. Age-adjusted per 100,000 CRC mortality rate for adults 20–64 in 2013. Darker colors reflect increased mortality.

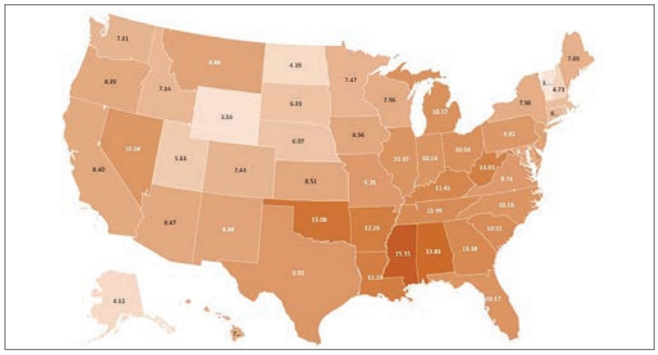

Figure 5. Age-adjusted per 100,000 CRC mortality rate for adults 20–64 in 2015. Darker colors reflect increased mortality.

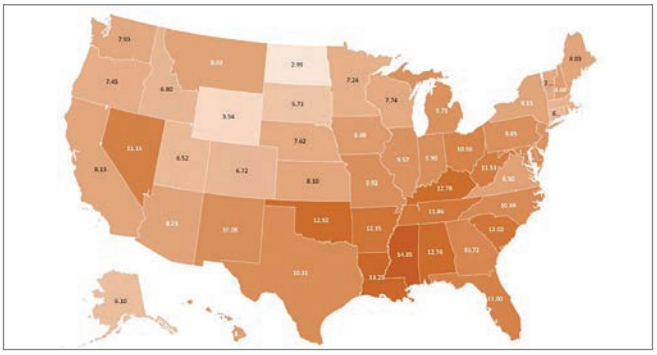

Figure 6. Age-adjusted per 100,000 CRC mortality rate for adults 20–64 in 2016. Darker colors reflect increased mortality.

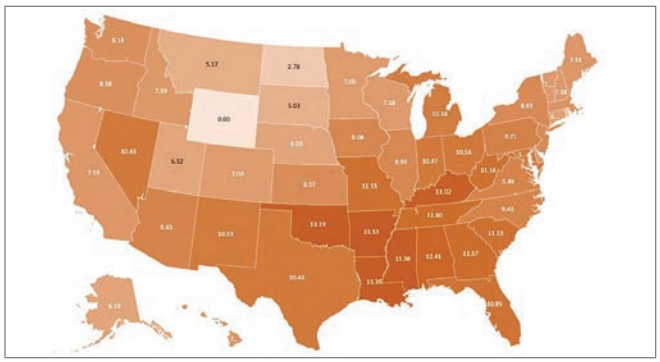

Figure 7. Age-adjusted per 100,000 CRC mortality rate for adults 20–64 in 2017. Darker colors reflect increased mortality.

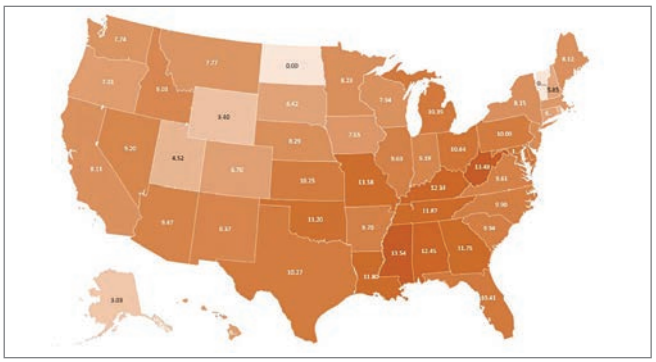

Figure 8. Age-adjusted per 100,000 CRC mortality rate for adults 20–64 in 2018. Darker colors reflect increased mortality.

	States											
Year	AK + HI	CA	CT	GA	IA	KY	LA	MI	NJ	NM	UT	WA
2012	N/A	0.19	0.48	0.22	0.69	0.46	0.29	0.45	0.31	N/A	N/A	N/A
2013	N/A	0.24	0.31	0.80	0.33	0.47	0.28	0.041	0.22	0.86	N/A	0.31
2014	N/A	0.012	0.48	0.68	0.01	0.41	0.041	0.60	0.78	N/A	N/A	0.97
2015	0.026	0.042	0.58	0.23	0.30	0.74	0.41	0.67	0.06	0.73	N/A	0.31

Table 1. Calculated p-values from 2x2 chi-square tests between race (white and black) versus age ranges (20-34 and 50-64). Highlighted findings significant at the p<0.05 level. N/A: not applicable.

	States											
Year	AK + HI	CA	CT	GA	IA	KY	LA	MI	NJ	NM	UT	WA
2012	N/A	0.45	0.52	0.75	0.41	0.51	0.15	0.34	0.60	N/A	N/A	0.28
2013	N/A	0.54	0.86	0.91	0.92	0.63	0.43	0.42	0.91	0.67	N/A	0.41
2014	N/A	0.96	0.60	0.92	0.70	0.87	0.12	0.97	0.17	0.60	0.20	0.67
2015	0.16	0.42	0.93	0.80	0.24	0.62	0.69	0.92	0.91	0.40	N/A	0.006

Table 2. Calculated p-values from 2x2 chi-square tests between race (white and black) versus age ranges (35-49 and 50-64). Highlighted findings significant at the p<0.05 level. N/A: not applicable.

	States											
Year	AK + HI	CA	CT	GA	IA	KY	LA	MI	NJ	NM	UT	WA
2012	0.0003	0.031	0.12	0.001	0.78	0.73	0.22	0.41	0.090	N/A	N/A	0.29
2013	N/A	0.12	0.068	0.049	0.56	0.40	0.29	0.59	0.19	0.95	0.13	0.35
2014	N/A	0.039	0.30	0.006	0.28	0.71	0.61	0.13	0.93	0.59	0.90	0.090
2015	0.74	0.72	0.35	0.085	0.64	0.63	0.43	0.57	0.19	0.61	0.26	0.78

Table 3. Calculated p-values from 2x2 chi-square tests between race (white and black) and insurance status (insured versus uninsured). Highlighted findings significant at the p<0.05 level. N/A: not applicable.

	Age Group x CRC Stage			
Year	20-34 against 50-64 Localized against Regional	35-49 against 50-64 Localized against Regional	20-34 against 50-64 Regional against Distant	35-49 against 50-64 Regional against Distant
2012	0.47	0.004	0.72	0.03
2013	0.32	6.6 E-05	0.69	0.08
2014	0.71	1.8 E-35	0.39	0.91
2015	0.86	3.5 E-08	0.59	0.522
2016	0.003	1.3 E-132	0.41	0.02
2017	0.001	1.2 E-132	0.08	0.07

Table 4. Calculated p-values from 2x2 chi-square tests between age cohorts (20-34, 35-49, 50-64) and stage of CRC during screening (localized, regional, distant). Highlighted findings significant at the p<0.05 level. Any E-values with an integer greater than 10 were considered not valid; therefore, not statistically significant.

age shift and increased mortality rates could be secondary to environmental and lifestyle factors such as diet, exercise, and the rising prevalence of obesity among younger individuals (3). In addition, the socioeconomic disparities already present in these locations further exacerbate the rising CRC mortality rates.

The results from the race versus age impact on CRC incidence trials were less informative, by virtue of inconsistent p-values and a concomitant lack of statistical significance from the chi-square tests. For the younger versus older age group, most of the expanded states and the single non-expanded state, Georgia, had p-values that were statistically non-significant over the 4-year span from 2012 to 2015. The exception to this included three Medicaid expanded states in 2014 — California (0.012), Iowa (0.01), and Louisiana (0.041) — along with the combined values of Alaska and Hawaii (0.026). These instances conveyed a tentative association between race and CRC incidence for the younger versus older age bracket. For the middle versus old age group, the non-expansion state of Georgia consistently had p-values over 0.7 similar to the values of the aforementioned group. There were frequent values of 0.9 or higher throughout the data for the remaining Medicaid expanded states except for Washington's p-value of 0.006 in 2015. The single instance that conveyed the association between race and incidence rate of the middle age group compared to the four instances of the younger age group were isolated exceptions of the calculations. Therefore, at best, the provisional characterization that can be made is that for most of the states in the used SEER database, race played little role in the CRC incidence rates.

The findings from analyses between race (white and black) and insurance status (insured versus uninsured) depicted that there was generally no conclusive relationship between these two factors in the Medicaid expansion states. California was the only expanded state with at least two instances (0.031 and 0.039) where race and insurance influenced the CRC incidence rate in 2012 and 2014, respectively. These instances possibly arose due to the largely diverse demographic of California residents alongside socioeconomic transitions between these two years. The single non-expanded state of the cohort, Georgia, had three consecutive years (2012–2014) where race and insurance status did have an influence on CRC incidence rates for that state (0.001, 0.049, 0.006, respectively). The majority of expanded states not experiencing this relationship suggested that Medicaid may reduce the possibility of race influencing CRC incidence based on insurance status. This coincided with the true intention of the expansion to remove the possibility of insurance status hindering or negatively impacting the health care individuals receive. However, states without the wide-ranging public insurance option did not necessarily protect and prevent the disparities faced by those of different racial groups and having access to health insurance. This in turn would be anticipated to impact the possibility and availability for individuals without insurance to receive proper preventive health care services, thus increasing CRC incidence rates despite Medicaid expansion.

The observed findings regarding the stage of CRC upon diagnosis by age range across the states generally demonstrated that the middle age grouping (35–49) was at a higher risk for being diagnosed at a later stage of CRC.

The years examined (2012–2017) showed a strong correlation between the middle age group and the older age group (50–64) and the stage of diagnosis. It is worth noting that a longer interval between confirmed CRC diagnosis to start of treatment has been associated with a significant increase in mortality rate across all cancer stages. Risk of death was 1.64 times more likely for those treated over 151 days after confirmed diagnosis compared to those treated within 30 days of diagnosis. Those under the age of 44 had a higher mortality rate (41.59%) than those in the 45–54 age cohort (36.79%) and the 55–64 age cohort (34.77%). Higher mortality rates in young patients are thought to be due in part to later diagnoses and longer treatment delays, both of which may be minimized with more age-appropriate diagnostics and a shift away from the perspective that CRC only affects older individuals (17). The main limitation for the study is that there was only one Medicaid non-expansion state available for CRC incidence in the SEER database (out of 21 total non-expansion states as of April 2015) (18). Some of the states included as part of this study (e.g., Alaska and Hawaii) had very minimal samples but were retained to refrain from discarding any of the limited data.

Conclusion

Our findings suggest that many younger individuals have their CRC symptoms misdiagnosed or undiagnosed until the later stages of the disease, which are consequently more lethal. The direness of the situation could be further exacerbated for certain minority racial groups in having higher uninsured statuses, placing these individuals at higher risk for not getting proper preventive care and timely diagnosis for CRC. With this trend seen in Georgia, other non-expanded states located in the Southeast region may have CRC patients facing similar disparities. Further research is warranted to fully substantiate this data across the broader array of the U.S., but the results suggest that leveraging openings produced by Medicaid expansion to increase early screening and detection of CRC throughout these areas may reduce the recent uptick in mortality rates for younger individuals (birth–49) (4). Thus, there is an essential need for a more comprehensive analysis on the effects of Medicaid expansion and additional evidence affirming the benefits of lowering the CRC screening age in order to contemplate the need for vital, life-sustaining legislature.

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Disclosures

The authors do not report any conflict of interest.

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