A narrative review of sociodemographic risk and disparities in screening, diagnosis, treatment, and outcomes of the most common extrathoracic malignancies in the United States

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Abstract: There is a well-established association between multiple sociodemographic risk factors and disparities in cancer care. These risk factors include minority race and ethnicity, low socioeconomic status (SES) including low income and education level, non-English primary language, immigrant status, and residential segregation, and distance to facilities that deliver cancer care. As cancer care advances, existing disparities in screening, treatment, and outcomes have become more evident. Lung cancer remains the most common and fatal malignancy in the United States, with breast, colorectal, and prostate cancer being the three most common and deadly extrathoracic malignancies. Achieving the best outcomes for patients with these malignancies relies on strong physician-patient relationships leading to robust screening, early diagnosis, and early referral to facilities that can deliver multidisciplinary care and multimodal therapy. It is likely that challenges experienced in developing patient trust and understanding, providing access to screening, and building referral pipelines for definitive therapy in lung cancer care to vulnerable populations are paralleled by those in extrathoracic malignancies. Likewise, progress made in delivering optimal care to all patients across sociodemographic and geographic barriers can serve as a roadmap. Therefore, we provide a narrative review of current disparities in screening, treatment, and outcomes for patients with breast, prostate, and colorectal malignancies.

Keywords: Social determinants of health; cancer disparities; sociodemographic risk; screening disparities

Introduction

Lung cancer is both the most common and fatal malignancy among American men and women. Colorectal, breast, and prostate cancer remain the three most common and fatal extrathoracic malignancies (1). Precision medicine, a global term encompassing our ability to combine early diagnosis with safe application of surgery, radiation, endocrine, cytotoxic, and targeted molecular and immune therapies, has improved outcomes for those who can receive such comprehensive care (2-4).

Disparities in every phase of oncological care, from screening to delivery, have become evident among vulnerable populations (1,5,6). These populations have been identified as high risk based on race, ethnicity, gender, socioeconomic status (SES), education status, immigrant status, primary language, place of work, access to care, and residential segregation, and distance from healthcare facilities, among other sociodemographic factors. As we look to address these disparities in patients with lung cancer, it is helpful to understand how sociodemographic risk has

impacted care in common malignancies that similarly rely on screening and multimodal therapy for optimal outcomes. Here, we provide a narrative review and commentary of disparities that exist among vulnerable populations in breast, prostate, and colorectal cancer (CRC) outcomes, screening, diagnosis, management, and outcomes. We present the following article in accordance with the Narrative Review reporting checklist (available at: http://dx.doi.org/10.21037/jtd-21-87).

Methodology

A literature search was performed using the MEDLINE PubMed catalog using a combination of keywords including "racial disparities", "ethnic disparities", "social determinants of health", "socioeconomic status", "primary language", "immigrant status", "screening disparities", "treatment disparities", "rural cancer care", "urban cancer care", "breast cancer", "colorectal cancer", and "prostate cancer". Full text articles written in the English language and published between the years 2000 and 2020 were subjectively assessed by the authors for content and relevance.

Breast cancer

Breast cancer is the most common-invasive cancer in women worldwide, affecting 1 in 7 women (7,8). For women of average risk, the U.S. Preventive Services Task Force (USPSTF) and American College of Physicians (ACP) recommends mammography every two years in women between the ages of 50 and 74 (9). When diagnosed early, breast cancer is curable with a multimodal approach to therapy, even for cancers that have high risk molecular profiles. Advances in the application of endocrine and targeted therapies make the prospect of long-term disease control an increasing reality even in late stage disease (10). Risk stratification, however, extends beyond biology. Both biological and sociodemographic factors affect breast cancer outcomes, indicating the need to understand the impact of both sets of risk factors on outcome disparities (11). *Table 1* summarizes the following sections in outcomes, screening, and treatment disparities in breast cancer care.

Outcome disparities

Multiple studies have shown higher rates of morbidity and mortality in breast cancer in vulnerable populations (12). Much of this data stems from population-based samples

that have represent a substantial portion of the United States population. For example, one population-based study using the Surveillance, Epidemiology, and End Results (SEER) database and data provided by the North American Association of Cancer Registries (NAACR) of all women diagnosed with breast cancer between 2005 and 2017 showed that non-Hispanic Black (NHB) women have higher breast cancer mortality rates than non-Hispanic White (NHW) women, with rates as much as 39% higher [mortality rate ratio (MRR), 1.39; 95% confidence interval (CI), 1.35–1.43] in NHB women in 2015. These data represent a significant gap in survival and one that widened in the preceding half decade (2). The same study found that, from 2005 to 2014, overall breast cancer incidence increased yearly among Asian/Pacific Islander (1.7% per year), NHB (0.4% per year), and Hispanic (0.3% per year) women but were stable in NHW and American Indian/Alaska Native (AI/AN) women. Notably, breast cancer death rates were not significantly different in NHB and NHW women in 7 states (2). This may reflect either the existence of programs to ameliorate race-based survival disparities (e.g., mandatory insurance coverage), or more likely a lack of statistical power. Following Medicaid expansion, data from the Center for Disease Control and Prevention (CDC) was queried for survival disparities associated with race (13). There did not appear to be an association between state expansion of Medicaid and survival in breast cancer (13). This data demonstrates that the sheer existence of Medicaid expansion does not necessarily lessen survival disparities. However, a separate study by Abdelsattar *et al.* evinced that within the most disadvantaged populations, Medicaid coverage conferred a relative survival benefit over having no insurance (14).

With respect to racial and ethnic disparity, American Hispanics across all races have also been identified as a high-risk population, as they are more likely to be diagnosed at a younger age, have invasive cancer (compared to *in situ* disease), and triple negative disease relative to African American women. This is significant as Black women have already been identified as a vulnerable population (15). Interestingly, these racial disparities exist outside of the United States as well. A retrospective study aiming to identify associations between ethnicity and breast cancer survival in New Zealand found that Maori/Pacific women were at higher risk of excess mortality from breast cancer. Maori/Pacific patients were diagnosed at a younger age, with a higher burden of comorbidity, and were more likely to reside in lower SES neighborhoods. These women

Table 1 A summary of studies examining disparities in screening, delivery, and outcomes in breast cancer care

Study focus	Journal	Author and year	N	Study type	Summary
Outcome	*CA Cancer J Clin*	DeSantis *et al.* 2017	N/A	Overview of national databases and registries	• Non-Hispanic Black women have higher breast cancer death rates than Non-Hispanic Whites women (39% higher 2015)
	Cancer Med	Nahleh *et al.* 2018	3,441	Retrospective analysis of a multi-institutional cohort	• Hispanic Americans were more likely to be diagnosed with breast cancer younger, have invasive ductal carcinoma type (82.7%), have triple negative disease (17.1%, 95% CI: 15% to 19%), and have a higher prevalence of triple negative disease compared to Black patients
	BMC Cancer	Tin Tin *et al.* 2018	13,657	Retrospective analysis of a health region in New Zealand	• Maori women had a higher risk of excess mortality from breast cancer (aHR 1.76, 95% CI: 1.51–2.04 for Māori and 1.97, 95% CI: 1.67–2.32 for Pacific women)
	Journal of Global Oncology	Semprini *et al.* 2019	N/A	Retrospective cohort study of national databases	• Medicaid expansion increased the Black/White mortality ratio (P=0.01 to P=0.15)
	Cancer	Abdelsattar *et al.* 2016	134,105	Retrospective cohort study of a national database	• Having insurance improved cancer-specific survival the most in disadvantaged communities (3 years, 40% *vs.* 31%)
	Milbank Q	Silber *et al.* 2018	64,744	Retrospective cohort study of a national database	• Low socioeconomic status patients were diagnosed with more stage IV disease (P<0.0001), larger tumors (P<0.0001), and lower median survival (P<0.0001)
	Cancer	Balazy *et al.* 2019	1,057	Retrospective cohort analysis at a single institution	• Non-English speaking patients were significantly more likely to present at advanced stage compared to English speaking patients (OR 1.47, 95% CI: 1.001–2.150, P=0.0082)
	In J Breast Cancer	Parikh *et al.* 2015	1,128	Retrospective cohort analysis at a single institution	• There was no significant difference in mortality of breast cancer patients by race/ethnicity, primary language, insurance type, or income at a safety net academic hospital
Screening	*Ann Surg Oncol*	Newman *et al.* 2017	N/A	Review	• Frequency of breast cancer detected at Stage I is more than 10% lower in Black and Hispanic patients compared with White patients
	J Womens Health	Hirth *et al.* 2016	4,992	Cross-sectional observational study	• Higher income white women were more likely to report having a mammogram (aPR 1.63, 95% CI: 1.04–2.55) compared to lower income white women
	Am J of Surg	Simianu *et al.* 2016	6,286	Prospective cohort study in Washington State	• Native Americans with breast cancer received preoperative diagnostic core-needle biopsy less frequently (81% *vs.* 94%, P=0.004) and their tumor's hormone receptor (ER/PR) status was less frequently reported (92% *vs.* 99%, P=0.008) compared to non-Hispanic White women

Table 1 (*continued*)

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Study focus	Journal	Author and year	N	Study type	Summary
Treatment	*Breast Cancer Res Treat*	Hoppe *et al.* 2018	546,351	Retrospective cohort study of a national database	• Black women had significantly longer times to first treatment, surgery, chemotherapy, radiation, and endocrine therapy than White women (P<0.001)
	JAMA Surg	Lautner *et al.* 2015	727,927	Retrospective cohort study of a national database	• Rates of breast conserving therapy were lower in patients without insurance compared to private insurance (OR 0.75, 95% CI: 0.72–0.78) and patients with the lowest income (OR 0.92, 95% CI: 0.90–0.94)
	Cancer Epidemiol	Akinyemiju *et al.* 2016	67,000	Cross-sectional observational study	• Black patients were less likely to receive mastectomies regardless of insurance status (OR 0.80, 95% CI: 0.71-0.90), and more likely to experience post-surgical complications (OR 1.41, 95% CI: 1.12-1.78).
	Breast Cancer Res Treat	Dreyer *et al.* 2018	11,368	Retrospective cohort analysis at a single institution	• Poor patients were less likely to receive sentinel lymph node biopsy (OR 0.71, 95% CI: 0.59–0.80), radiation after breast conserving therapy (OR 0.59, 95% CI: 0.48–0.72), receive any axillary surgery (OR 0.69, 95% CI: 0.59–0.80), or adjuvant chemotherapy (OR 0.74, 95% CI: 0.61–0.90) compared to high SES patients
	Eur J Surg Oncol	Mets *et al.* 2018	1,045	Retrospective analysis at a single institution	• Hispanic and Black patients had higher rates of overall complications (34.1% *vs.* 27.4%, P=0.021); also with higher rates of neoadjuvant chemotherapy (P=0.036), history of radiation (P=0.016), were more likely to undergo modified radical mastectomy (P=0.002) over nipple-sparing mastectomy (P=0.035), and higher rates of reconstructive complications (P=0.023)

were less likely to be diagnosed via screening, treated in a private care facility, receive timely treatment, and receive breast conserving surgery (16). This data suggests that sociodemographic risk confers similar and striking disparities in diagnosis and utilization of care globally.

SES has also been shown in several studies to be an independent risk factor associated with poor survival in patients with breast cancer. Using the SEER database, Silber *et al.* defined low SES using neighborhood poverty as well as education level and found a drastic decrease in survival for patients from low socioeconomic backgrounds compared to controls while accounting for treatment, stage at presentation, and other sociodemographic risk factors (17).

There is a paucity of data associating primary language and patients with non-English speaking backgrounds and outcomes in breast cancer. One single institution study from a quaternary care academic center demonstrated that non-

English speaking patients comprised of 15% of the total cohort and were more likely to present at later stages (18). A separate single institution study from an urban safety-net hospital over a similar time period found that just over 25% of patients were non-English speaking and did not experience any difference in mortality compared to English speaking patients. Furthermore, survival in this study was similar to national datasets (19).

Screening and stage of presentation

Currently, the USPSTF recommends mammography every two years in women between the ages of 50 and 74 (9). Unfortunately, disparities are evident in completion of screening mammography due to lower SES (including income, race, and ethnicity). Initial mammography utilization rates have been reported as similar for Black

and White American women by the American Cancer Society at 68% and 71%, respectively in the year 2000; however, repeat utilization of mammography is significantly lower for Black women than for White women (20). Despite the absence of large-magnitude variation initial mammography utilization, frequency of breast cancer detected at Stage I is more than 10% lower in AAs and Hispanic Americans compared with White Americans (21). Hirth *et al.* highlighted that insurance coverage was associated with undergoing screening mammography only among White and Hispanic women (22). These authors additionally demonstrated the significance of SES with relation to receipt of screening mammography. In their cross-sectional study associating demographic data with screening mammography rates that White patients with a higher household income were more likely to report having a mammogram (aPR 1.63, 95% CI: 1.04–2.55) compared to lower income White women (22).

While Black/White racial disparities are clear in breast cancer screening and diagnosis, there is limited data exploring disparities in other under-represented minority races (2,23). Simianu *et al.* identified that American Indian/Alaskan Native patients with breast cancer less frequently received preoperative diagnostic core-needle biopsy (81% *vs.* 94%) and their tumor's hormone receptor (ER/PR) status was less frequently reported (92% *vs.* 99%), compared to NHW and other races. This dataset was limited to a Washington state registry of patients already receiving surgical care, and consequently may underestimate disparities in screening, diagnosis, and treatment though it does provide a possible mechanism by which delivery of standard of care therapies is not necessarily standard across demographic groups (23).

Treatment

The main avenues for current breast cancer therapy include endocrine, cytotoxic, targeted, and surgical therapy. The complexity of surgical decision making alone further allows for variable treatment patterns. While population-based studies have been valuable in identifying disparities in care, such studies are unable to capture granular data in this decision-making process.

Despite these limitations, current literature demonstrates that treatment based disparities still exist even in early stage surgical management of breast cancer (21). For example, Hoppe *et al.* evaluated persistent racial disparities in the treatment of stage 1 breast cancer patients and found that

Black women have longer times to first treatment, surgery, chemotherapy, radiation, and endocrine therapy than White women (24). A similar study conducted by Mets *et al.* characterized racial disparities among patients who receive breast mastectomy and reconstruction found that Hispanic and African American patients were more likely to undergo modified radical mastectomy (P=0.002) over nipple-sparing mastectomy (P=0.035) (12). Reconstructive complications revealed a higher overall complication rate (P=0.023), higher rates of partial mastectomy flap necrosis (P=0.043), as well as arterial (P=0.009) and venous insufficiency (P=0.026) during microvascular reconstruction among Hispanic and African American patients (12). Lautner *et al.* queried the National Cancer Database (NCDB) to assess the utilization of breast conserving surgery in patients with early stage disease and found that Medicaid-insured, uninsured, and low income patients less likely to undergo breast conservation therapy than privately insured and higher income patients (25). Additionally, Akinyemiju *et al.* assessed outcomes for patients undergoing inpatient treatment for breast cancer and similarly found lower rates of breast conserving surgery for Black patients as well as higher complication rates (26). Dreyer *et al.* examined the SEER database between the years 2006 and 2009 and stratified SES into quartiles based on poverty indices, per capita income, household incomes, and Medicaid insurance status. Poverty-stricken patients were less likely to undergo initial surgical management, nodal staging, and perioperative radiation and chemotherapy (27).

CRC

CRC is the third most common cancer and cause of cancer deaths in men and women in the United States (28). The USPSTF currently recommends that individuals at average risk start colorectal screening at the age of 50 with yearly stool-based tests and colonoscopies every 10 years until the age of 75 (29). With the advent of current screening guidelines, CRC mortality has improved markedly by improving early detection (3). The current therapeutic standard for CRC once diagnosed is dependent upon the stage of disease. Surgical resection with or without perioperative chemotherapy or radiation therapy is the only curative treatment modality for locoregional CRC (3). Despite global advances in both screening and therapy, there are vast disparities in diagnosis, treatment, and outcomes in CRC that are dependent upon sociodemographic risk factors. *Table 2* summarizes the following sections in

Table 2 A summary of studies examining disparities in screening, delivery, and outcomes in colorectal cancer care

Study focus	Journal	Author and year	N	Study type	Summary
Outcome	*Cancer*	White *et al.* 2013	37,769	Retrospective observational study using national database	• Black patients were found to have a lower CRC-specific survival compared to White patients (aHR 1.24, 95% CI: 1.14–1.35)
	Ann Surg Oncol	Nitzkorski *et al.* 2013	748	Retrospective study of prospectively maintained database	• Median overall survival for all stages was worse for nonwhite patients (31 *vs.* 50 months, P<0.001), and those with low income and education
	J Clin Oncol	Robbins *et al.* 2012	N/A	Retrospective observational study using national database	• Between the 1980s and 2000s, CRC mortality decreased for each stage in both Black and White pts, but for all stages, the decreases were smaller for Blacks (P<0.01)
	J Immigr Minor Health	Domingo *et al.* 2018	12,921	Survey analysis	• Filipinos, Chinese, and Hawaiian patients were significantly less likely than Whites to be compliant with CRC screening and treatment guidelines (OR 0.56, 0.70, 0.75, respectively)
Screening	*Am J Public Health*	Ahmed *et al.* 2013	5,900	Cross-sectional survey study	• Compared with Whites, Hispanics were 34% less likely (P<0.01) and Blacks were 26% less likely (P<0.05) to receive CRC screening and/or screening recommendations
	J Racial Ethn Health Disparities	Mobley *et al.* 2017	558,568	Retrospective observational study using national database	• African-Americans, Hispanics, and Asians were more likely to be diagnosed at a late stage for CRC or both than whites in many states (P<0.05)
	J Community Health	Nagelhout *et al.* 2017	197	Cross-sectional observational study	• After adjusting for age and gender, Hispanic patients were less likely to report having discussed CRC screening options compared to White patients (OR =0.24, 95% CI: 0.09–0.68, P<0.05)
	Updates Surg	Patel *et al.* 2019	249,100	Retrospective observational study using national database	• Stage of diagnosis was significantly associated with race, age, insurance status, percent of population below poverty line, percent of language-isolated persons, and percent of unemployed (P<0.05)
	J Community Health	Chan *et al.* 2016	311	Retrospective analysis of a single institution cohort	• Blacks were significantly more likely to have advanced stage CRC [3–4] at diagnosis compared to Whites (OR 3.70, 95% CI: 0.97–14.11, P=0.055)
	Cancer	Brawarsky *et al.* 2013	6,986	Retrospective observational study using national database	• Blacks were less likely than Whites to undergo colonoscopy (OR 0.76, 95% CI: 0.69–0.83) and to receive CEA testing and overall surveillance
	Am J Surg	Carmichael *et al.* 2019	486,303	Retrospective observational study using national database	• Highest screening rate states had the smallest urban-rural disparities while lowest screening rate states had the largest disparities (74.6% *vs.* 73.0%, 1.6% difference *vs.* 1.3% *vs.* 56.9%, 4.4% difference)

Table 2 (*continued*)

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Study focus	Journal	Author and year	N	Study type	Summary
	Cancer Epidemiol	Pulte *et al.* 2017	102,509	Retrospective observational study using national database	• Survival was found to be greater for patients with insurance other than Medicaid for all races with the differential in survival varying by race (Medicaid *vs.* other in all races: 79.6 *vs.* 91.2)
	Am J Surg	Schlottman *et al.* 2020	361,187	Retrospective observational study using national database	• Patients who were at least 18 miles from a cancer center were diagnosed at later stage (OR 1.2, 95% CI: 1.17–1.23)
					• Black and other non-White patients were more likely to be diagnosed with stage III (OR 1.06, 95% CI: 1.03–1.1; OR 1.14, 95% CI: 1.08–1.2, respectively) or stage IV disease (1.34, 95% CI: 1.30–1.37; OR 1.04, 95% CI: 1.00–1.10)
Treatment	*Dis Colon Rectum*	Laryea *et al.* 2014	878	Retrospective cohort study of a single institution cohort	• Equal proportions of Blacks and Whites underwent surgery (P=0.84), received chemotherapy (P=0.18), and received radiation therapy (P=0.31). Prior disparities notes at the institution were mitigated
	PLoS One	Tramontano *et al.* 2020	115,604	Retrospective observational study using national database	• Non-Hispanic Blacks were less likely to receive surgery (OR 0.76, 95% CI: 0.62–0.72, P<0.0001), radiation (OR 0.76, 95% CI: 0.65–0.89, P=0.0005), or chemotherapy (OR 0.798, 95% CI: 0.74–0.84, P<0.0001); however, they were more likely to have higher cancer-attributable costs (OR 1.19, 95% CI: 1.02–1.40, P=0.03)
	Cancer Epidemiol	Alese *et al.* 2019	83,449	Retrospective observational study using national database	• Delivery of surgery and perioperative therapy was not statistically different across race or ethnicity
					• Black (HR 1.42; 1.38–1.46, P<0.001) and Hispanic (1/07; 1.02–1.12, P=0.004) patients had inferior median overall survival compared to NHW
	Int J Colorectal Dis	Al-Husseini *et al.* 2019	401,723	Retrospective observational study using national database	• NHW had a survival advantage over NHB and American Indians/Alaskan Natives (HR 1.12, 95% CI: 1.16–1.19, P<0.001; HR 1.11, 95% CI: 1.04–1.19, P=0.002)
	Ann Surg Oncol	Arsoniadis *et al.* 2018	22,697	Retrospective observational study using national database	• Black patients were less likely to receive sphincter-preserving operations compared to non-Black men (OR 0.74, 95% CI: 0.67–0.83)

outcomes, screening, and treatment disparities in CRC care.

Outcome disparities

Numerous studies have outlined racial/ethnic differences in outcomes for CRC survival. It has been well documented in population based studies that non-Hispanic Black men and women have the highest of CRC-related incidence and mortality (30). Investigators have tried to elucidate mechanisms for increased CRC-related mortality in Black and Hispanic patients, with some studies concluding that medical comorbidities and SES may be important contributing factors (31). A study by Nitzkorski *et al.* to evaluate racial and socioeconomic disparities in outcomes of patients with rectal cancer found that the median overall survival for all stages is worse for nonwhite patients, those with low income, and those with low education with disparities being most pronounced for those with advanced stage disease (32). Although CRC mortality has decreased as a whole, the improvement in survival has not been experienced equally among all races. A study conducted by Robbins *et al.* using the SEER database found that between 1985 and 2005, stage-for-stage mortality decreased, but to a lesser degree for Black patients compared to White. Again, this finding was most prominent in late stage disease where mortality rates accounted for 60% of the overall disparity in mortality (33). Though notable, this may reflect differences in decision making for patients with late-stage disease, rather than differences in access, availability, or efficacy of care itself. However, even at safety net hospitals with presumably greater accessibility to vulnerable populations, Black patients experienced a lower likelihood of survival compared to White patients [median overall survival of 1.9 and 2.5 years, respectively (HR =0.4, P=0.0467)] (34). Ultimately, oncologic outcomes are inextricably linked to disease stage.

Screening and stage of presentation

The evolution of current screening guidelines has led to a markedly improved CRC mortality rate by increasing detection of early stage malignancy (3). Unfortunately, disparities in screening and stage at presentation still exist and likely contribute to disparities in outcomes of CRC. A study by Ahmed *et al.* using data collected from 5,900 adults eligible for endoscopic screening for CRC from the National Health Interview Survey showed that compared with Caucasians, Hispanic are 34% (P<0.01)

and Black patients are 26% (P<0.05) less likely to receive a recommendation for CRC screening from providers (35). A similar study conducted using the SEER database showed Black patients are less likely than non-Black patients to have undergone CRC screening (75% *vs.* 82%, P=0.001), and were also less likely to be up-to-date with CRC screening (66% *vs.* 72%, P=0.001) (36). Furthermore, these disparities have been shown to exist even in Asian populations with studies showing that Filipinos (OR 0.56), Chinese (OR 0.70), and Hawaiians (OR 0.75) were significantly less likely than Whites to undergo CRC screening when recommended (34).

Mechanisms expanding upon screening disparities are multifactorial. A lack of explicit recommendations regarding screening from providers has shown to contribute to decreased screening rates in Hispanic patients compared to White patients (35,37). Furthermore, it has been shown that patient's perceived screening barriers, lack of awareness and a lack of provider communication about CRC screening options may contribute to low screening rates among minority populations (37). Several studies suggest that SES and access to health care may explain all major racial/ethnic disparities in CRC screening recommendation rates and screening compliance (34,35).

Residential segregation and distance to travel have also been identified as barriers to appropriate screening. For example, patients in areas with the largest capacity for CRC screening were more likely to receive a colonoscopy than those in areas with the greatest percentage of Black patients (38). Distance and access to screening programs also explains disparities that exist among rural populations (39,40). Carmichael *et al.* sought to assess adherence to recommended screening guidelines via a publicly available surveillance system and correlating screening participation with county CRC mortality from the National Cancer Institute (41). The authors found that states with the highest screening rates had the smallest urban-rural disparities, while those with the lowest screening rates had the largest disparities (41). Finally, they found that rural counties experienced ~5 more deaths per 100,000 population even after controlling for screening rates (41). Insurance status is another contributing disparity with a study showing that survival was greater for patients with insurance other than Medicaid for all races, but the differential in survival varied with race (42).

In addition to screening disparities, studies have revealed disparities in stage at presentation. One such population-based study conducted using the SEER database between

2007 and 2014 analyzed the impact of patient age, race, primary, site, state/county, and insurance status on cancer staging at diagnosis. This study found sociodemographic risk factors associated with a higher stage at diagnosis include low income, race/ethnicity, age, and gender (43). A smaller scale study, conducted at an urban-safety net hospital found that Black patients are nearly four times as likely to have stage III-IV CRC at diagnosis compared to Whites (P=0.055), thereby increasing the risk for cancer recurrence and mortality and further substantiating these findings in diverse care settings (44). Robbins *et al.* identified that the disparity in late-stage mortality accounted for approximately 60% of the overall Black-White mortality disparity in CRC, and concluded that concerted efforts to prevent or detect CRC at earlier stages in Black patients could improve observed racially driven disparities (33).

Treatment

Treatment differences in vulnerable populations in addition to poor access to screening and provider driven education likely contribute to survival and morbidity disparities. A retrospective study by Laryea *et al.* found no difference in overall survival or cancer specific mortality between Whites and Blacks in a study where Blacks and Whites were treated identically. This may indicate that provider centered treatment may be significantly contributing to poorer outcomes for Black patients (45). Despite this, Tramontano *et al.* found that after controlling for patient and clinical characteristics, NHB were less likely to receive treatment but were more likely to have higher cancer-attributable costs within different phases of care (46). Finally, differences in the extent of surgical resection, namely sphincter preservation in rectal cancer treatment is also evident. In a single institution study with a cancer center and a safety-net affiliate, sphincter preservation was less likely for those with the lowest quartile of income (32). In a separate population based study using the nationwide inpatient sample (NWIS), both Black patients and Medicaid insured patients were less likely to undergo sphincter preservation than White and privately insured patients (47). This may reflect less use of sphincter preserving perioperative therapy, patient misperception of disease process, or a lack of physician led communication and education.

Prostate cancer

The incidence and mortality of prostate cancer in Black men in the United States is disproportionately high (48). There are several hypotheses regarding both biologic and sociodemographic risks that are potentially unique to Black men compared to White men (49,50). While the total incidence of prostate cancer has declined in recent years, the rate of metastatic prostate cancer remains high among Black Americans (1,51,52). Additionally, patients with low relative income, those from disadvantaged neighborhoods, and those with limited social support have experienced disparate prostate cancer specific care including screening, diagnosis at an intervenable stage, and therapy (49,51-74). These risks have come into sharper focus as guidelines for screening men for prostate cancer have shifted over time. The use of prostate specific antigen (PSA) screening and early screening are now largely dependent upon shared decision making on the part of providers and patients. *Table 3* summarizes the following sections in outcomes, screening, and treatment disparities in prostate cancer care.

Outcomes disparities

Several studies have outlined differences in survival in vulnerable populations defined by multiple independent sociodemographic risk factors. Disparities in prostate cancer specific survival in Black men compared to White men have been demonstrated in both retrospective nationwide and statewide observational database driven studies as well as using predictive modeling from institutional data (51,52,54-56,61,64,65,72). Compared to NHW men, Black men carried up to 60% higher risk of mortality (56). Additional data from the California Cancer Registry attempting to identify prognostic sociodemographic risk factors suggests that Hispanic immigrants at a prostate cancer specific mortality that was 20% greater than that of NHWs (54).

A separate study from a statewide database in California revealed that men from disadvantaged neighborhoods as determined by census income, education, and occupation data have a higher risk of mortality from prostate cancer (70). While both race and SES have been shown to be risk factors for mortality in the United States, these factors are difficulty to distinguish as independent risk factors. Interestingly, low SES has also been shown to have almost a 20% increased incidence of mortality in a Swedish population based study examining a relatively homogenous population with a nationalized health plan (73). A common theme amongst high risk sociodemographic groups is that these patients tend to present at a later stage compared to their lower risk counterparts and often undergo less aggressive therapies

Table 3 A summary of studies examining disparities in screening, delivery, and outcomes in prostate cancer care

Study focus	Journal	Author and year	N	Study type	Summary
Outcome	*Cureus*	Wang *et al.* 2017	28,956	Retrospective observational study using national database	• Asian Americans with increased prostate cancer specific mortality compared to AA and NHW (AHR 2.295, P<0.001; 1.989, P<0.001; respectively)
	Cancer	Schupp *et al.* 2014	35,427	Retrospective observational study using a state registry	• Survival among Hispanic US-born men with prostate cancer who live in communities with a high density of Hispanic inhabitants is worse than Foreign-born Hispanic men in high density neighborhood and worse than US or Foreign-born men in low density Hispanic neighborhoods [HR 0.84; 95% CI: (0.78–0.9)]
	JAMA Network Open Urology	Fletcher *et al.* 2020	229,771	Retrospective observational study using national database	• Nearly 25% of analyzed state cancer registries showed a higher prostate cancer specific mortality in Black men compared to White men with low grade disease
	J Clin Onc	Ellis *et al.* 2017	270,101	Retrospective observational study using a state registry	• Cancer specific mortality 60% higher in black compared to NHW men (HR 1.60; 95% CI: 1.52–1.69) • Factors influencing survival difference included marital status, neighborhood socioeconomic status
	Cancer	Aizer *et al.* 2014	1,001,978	Retrospective observational study using national database	• Black men had a worse cancer specific mortality after adjusting for stage and sociodemographic factors compared to white men [HR 1.36, 95% CI: (1.27–1.46)]
Screening & presentation	*J Natl Med Assoc*	Percy-Laurry *et al.* 2018	945	Retrospective observational study using national database	• Black men with a high school level education were more likely to present with high-grade tumors than Black men with higher degrees of education [1.73; 95% CI: (1.11–2.71)]
	Cancer Causes & Control	Owens *et al.* 2019	76	Cross sectional survey of Black men from single institution cohort	• There was a 21% response rate (76 responders) • Only ~33% of respondents participated in prostate cancer screening discussions with providers • There was no correlation between intention to engage in shared decision making with participation in shared decision making (P=0.37) or participation in screening (P=0.52)
	J Racial Ethn Health	Ogunsanya *et al.* 2017	267	Cross-sectional survey study	• Black men with private (OR =1.5; 95% CI: 1.37–2.18; P<0.05) or public insurance (OR =1.45; 95% CI: 1.29–3.18; P<0.01) were more likely than uninsured men to plan to get screened. Black men with a regular source of care (OR =2.61; 95% CI: 1.1–1.96; P<0.05) were more likely to undergo screening
	J Urology	Krishna *et al.* 2016	13,374	Retrospective observational study using national database	• A greater proportion of Black men (58%) did not undergo any surveillance strategy compared to White men (37%) • The likelihood of active surveillance among Black men was significantly lower (OR 0.4, 95% CI: 0.17–0.95; P=0.039) than White men

Table 3 (*continued*)

Table 3 (*continued*)

Study focus	Journal	Author and year	N	Study type	Summary
Treatment	*Ethnicity & Disease*	Watson *et al.* 2017	2,194	Retrospective observational study using a city registry	• Living in neighborhood with high SES associated with receipt of definitive treatment (OR 1.57; 95% CI: [1.01-2.42]
					• Among men receiving definitive therapy, Black men were less likely than White to receive radical prostatectomy [OR 0.71; 95% CI: (0.52–0.98)]
	Cancer	Mahal *et al.* 2018	155,524	Retrospective observational study using national database	• Black men more likely than White to present with metastatic disease [aOR 1.07 (1.01–1.13); P=0.015]
					• Medicaid [aOR 4.27 (4.01–4.55); P<0.001] and Uninsured [aOR 4.12 (3.8–4.48); P<0.001] more likely than privately insured patients to present with metastatic disease
					• Black men less likely than White men to undergo definitive therapy [aOR 0.96 (0.93–0.99); P=0.03]
					• Medicaid [aOR 0.67 (0.62–0.71); P<0.001] and Uninsured [aOR 0.48 (0.44–0.52); P<0.001] less likely than privately insured men to undergo definitive therapy
					• Prostate cancer specific mortality more likely in Medicaid [aHR 1.83 (1.5–2.24); P<0.001], Uninsured [aHR 1.80 (1.4–2.31); P<0.001] than privately insured patients and in Black men [1.16 (1.01–1.33); P=0.038] than White men
	Cancer Causes & Control	Lee *et al.* 2018	604	Observational retrospective analysis of prospectively collected database	• Black (45%) and Hispanic (56%) men with low risk prostate cancer received external beam radiation therapy that met all quality metrics compared to 75% of White men (P=0.007)
					• Physicians treating black men had a lower average compliance to quality measures than those treating white men (P=0.025) and Hispanic men were more likely to receive care by physicians with lower adherence to quality metrics than white men (4% *vs.* 19%; respectively, P=0.016)
	Cancer	Gordon *et al.* 2019	1,170	Observational study survey of Black men from statewide prostate cancer survivorship registry	• A greater percentage of Black men did not perceive high risk cancers as aggressive cancers compared to White men (53.9% *vs.* 24.0%; P<0.001) though this was not associated with a difference in receipt of therapy

(48,55,60,69,73,75).

Screening, stage of presentation, and surveillance

The methodology and nature of screening in prostate cancer has evolved significantly over the past decade. In 2012, the USPSTF formally recommended against PSA screening based on analysis of the Prostate Lung Colorectal and Ovarian cancer dataset in which only 4% of the studied population were of Black race (65). Furthermore, concomitant studies demonstrated that Black men presented more often with more aggressive, advanced disease (48).

Since then, the USPSTF and American Urological Association have published screening recommendations for the early detection of prostate cancer that are essentially predicated upon shared decision making between providers and patients (76,77). Using the SEER database, Mahal *et al.* demonstrated not only that Black men had a 7% higher chance of presenting with metastatic disease than White men, but that the odds of presenting with metastatic disease was over four times higher in Medicaid-insured and uninsured populations compared to those with private insurance (65). A study using the Pennsylvania state cancer registry identified impoverished and immigrant populations based on US census data as variables that were associated with late stage at presentation (78). The study also indicated that a lack of social support was associated with late stage at presentation, which has been shown in other studies as well as single men more often presented with metastatic disease than married men (52).

Surveillance of disease for patients with prostate cancer who are not undergoing active therapy can vary in the degree of aggressiveness. The extent to which patients undergo active surveillance compared with expectant management is again a shared decision between patient and provider and can lead to earlier institution of therapy when indicated (59,60). Krishna *et al.* showed in a study of the SEER database that Black men are less likely to participate in active surveillance comprised of serial PSA, frequent biopsies, and semiannual history and physical exams (62).

Perhaps the most important factor in the pathway of prostate care for men from vulnerable populations is the relationship with a primary care provider. Given the risk of developing cancer that is associated with Black race, there must regular discussions between patients and physicians regarding the benefits and harms of prostate cancer screening and subsequent treatment. The risk of overdiagnosis and overtreatment should seriously be considered given data suggesting that up to 50% of men are overdiagnosed, biopsy alone carries a 2–5% risk of complication, and definitive treatment exposes 20% of patients or more to significant morbidity (77,79,80). The risk of overdiagnosis and treatment is further highlighted by data emphasizing the importance of quality of life particularly in Black men compared to White men (59). Communication between primary care physicians and patients from disadvantaged populations must be strengthened, given the evidence suggesting that there is a discordance between patient perception and the nature of their diagnosis (59).

Treatment

Krishna *et al.* highlighted differences in active surveillance for Black men with low risk prostate cancer compared White men (62). This is in concordance with studies that have shown that Black men present with higher stage and grade disease. Notably, several authors have demonstrated that Black and Hispanic men are less likely than White men to receive definitive therapy, including radical prostatectomy, external beam radiation, and brachytherapy (63). While population-based studies have generally suggested that fewer treatment options are both presented to and administered for minority patients, there is a paucity of studies that attempt to ascertain the perception of such interactions from the standpoint of the patient. Gordon *et al.* assessed the perceptions of Black men regarding their diagnoses and summarized their priorities with respect to cancer treatment (59). The focus of both Black and White men who perceived their cancers as aggressive was curing their disease. Black men who perceived that they had less aggressive disease placed much more importance on the cost of care, time to recovery, and impact on daily life (59). Most importantly, the study highlighted that significantly more Black men perceived their cancers to be less aggressive than they truly were, and in turn were less likely to receive definitive therapy compared to patients who perceived having more aggressive cancers (59).

Future direction

Given the multitude of barriers to care that exist for vulnerable populations, it is important to study how providers have both succeeded and failed in mitigating them. Studies that have quantified the impact of Medicaid expansion have shown that survival outcomes between now-Medicaid insured and privately insured patients are not nearly equivalent, but at the very least Medicaid insured patients had improved survival relative to uninsured patients (14). Other approaches that have been successful include culturally tailored education and navigation services which may be effective in reducing these disparities and financial incentives to decrease screening disparities among some sociodemographically disadvantaged groups (34,81).

Intuitively, the approach to sociodemographic healthcare disparities must be similar to the concept of precision medicine—targeted and synergistic. To reduce these disparities, community resources including education, outreach, prevention, and screening must be strengthened,

and aid in navigating the healthcare system once a diagnosis is made should be provided. Recent data strengthening the association between residential segregation, rural locations, and distance to travel for care and screening, treatment, and outcomes in cancer care has given us a starting point to for outreach (39,40,69,82-86). Relationships between surgeons, oncologists, and primary care providers who care for patients in these regions must be strengthened such that there is a common and up-to-date understanding of solid tumor screening guidelines. Referral pipelines to facilities that can either provide or coordinate definitive, multimodal therapy must be created with attention to anticipated patient care needs and potential difficulties with insurance coverage. Such models of partnership are already being built, and frameworks for the creation of such community outreach programs are available (87).

Lung cancer remains the most lethal and among the most commonly diagnosed cancers in the United States, along with breast, colorectal, and prostate cancer. Like breast, colorectal, and prostate cancer, lung cancer shares common disparities in screening, treatment, and outcomes and likely shares similar solutions (88-94). Similar to the progression of screening recommendations in breast and prostate cancer, the recommendation to screen patients for lung cancer will evolve as we are better able to quantify the risk conferred by demographic factors alone as well as the risks associated with consequent procedures for diagnosis and treatment. The adoption of safe, lung sparing, minimally invasive resections for early-stage disease may also significantly influence our recommendations to patients and referring physicians. This data will allow primary care providers, pulmonologists, and thoracic surgeons to engage in informative conversations and shared decision making.

Acknowledgments

Footnote

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