Title

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Journal

Journal of Clinical Oncology, 33(8)

ISSN

0732-183X

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Publication Date

2015-03-10

DOI

10.1200/jco.2014.56.8642

Peer reviewed

How do integrated health care systems address racial/ethnic disparities in colon cancer?

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Poster presentation at American Society of Clinical Oncology Quality Symposium November 2012, San Diego, California.

Manuscript word count (excluding bibliography and tables): 3901
Abstract word count: 246

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Abstract

Purpose Colorectal cancer (CRC) disparities have persisted over the last 2 decades. CRC is a complex disease requiring multidisciplinary care from specialists who may be geographically separated. Few studies have assessed the association between integrated health care system (IHS) CRC care quality, survival and disparities. The purpose of this study was to determine if exposure to IHS positively impacts quality of care, risk of mortality and disparities. **Patients and Methods** This study is a retrospective, secondary data analysis using California Cancer Registry linked to state discharge abstracts of patients treated for colon cancer (2001-2006). We compared the rates of National Comprehensive Cancer Network (NCCN) guideline based care; the hazard of mortality; and racial/ethnic disparities in IHS versus other settings. **Results** More than 30,000 patient records were evaluated. IHS had overall higher rates of adherence to NCCN guidelines. Propensity score matched Cox models showed an independent and protective association between care in IHS and survival (Hazard Ratio (HR) 0.87; 95%CI 0.85-0.90). This advantage persisted across stage groups. Black race was associated with increased hazard of mortality in other settings (HR 1.15; 95%CI 1.04-1.27); but there was no disparity within the IHS (HR 0.86; 95%CI 0.72-1.04) when compared to white race. **Conclusions:** IHS delivered higher rates of evidence based care; was associated with lower 5-year mortality. Racial/ethnic disparities in survival were absent in IHS. Integrated systems may serve as the cornerstone for developing Accountable Care Organizations, poised to improve cancer outcomes and eliminate disparities under Health Care Reform.

INTRODUCTION

Disparities in colorectal cancer (CRC) have persisted over the past 2 decades[1]. Minority patients have suffered disproportionately worse outcomes in both statewide[2-4] and national studies[5-9] of cancer treatment and survival. Further studies have shown racial/ethnic disparities by social characteristics[10,11] and other socio-economic status (SES) factors[12,13] More recent studies have suggested that differences in the receipt of appropriate care[7,9] and the location of care may also predict survival after treatment for cancer[14-16]. These studies suggest that minorities cluster for care in low performing hospitals[17,18] or hospitals that fail to adhere to evidence based care delivery [19]. Each of these studies underscores the correlation between the location of care and cancer survival and disparities.

CRC is a complex disease to treat, requiring care from a multidisciplinary group of specialists who may be geographically separated. Gaps in the delivery of multi-stepped care can have severe consequences on outcomes. For example, patients with stage III CRC who fail to receive chemotherapy lose a potential increase in survival of 15-30%[20-22]. Despite the well documented disparity in receipt of adjuvant therapy for various cancers[9,23] only a handful of investigations have assessed the survival impact of treatment within an integrated health care system[24,25]. Studies from the Veterans Administration (VA) health care system have suggested that use of a setting with standardized care may lead to equitable care delivery[25,26] and may decrease differences in outcomes by race/ethnicity[24]. To date, there have been no studies to compare quality of care, outcomes and disparities in

patients treated within an integrated setting to those treated in other settings, during a period of time preceding healthcare reform.

In our previous work, we have shown the importance of adherence with National Comprehensive Cancer Network (NCCN) guidelines for improving pancreas cancer survival[27]. We have also shown a correlation between the hospitals that serve high proportions of minorities and Medicaid recipients and low level adherence to NCCN guidelines for colon[19] and liver cancer[28]. These findings support the assertion that the location and type of care system used may have an impact on survival and disparities. In the current study we used a diverse, all-age, all-payer statewide cancer database, and propensity score matching techniques to assess outcomes after treatment for colon cancer in integrated versus other settings. We compared adherence with NCCN guidelines (appropriate surgery, pathological examination of >12 lymph nodes and stage specific chemotherapy); 5-year mortality and racial/ethnic disparities between integrated health systems (IHS) and all other settings. We hypothesized that IHS would have higher rates of NCCN guideline compliance and lower associated hazard of mortality than other settings. Secondarily, we hypothesized that racial/ethnic differences in receipt of evidence based care and mortality would be smaller in IHS than in other settings.

METHODS

Sources of Data

Institutional Review Board approval was obtained from Stanford University and the State of California Protection of Human Subjects to request and acquire a custom-designed data set comprised of elements from the California Cancer

Registry (CCR) and records from the California Office of Statewide Health Planning and Development Patient Discharge Data (OSHPD-PDD). The staff at the California Cancer Registry used ICD-O3 codes (C 18.0, 18.2-18.9) to identify all first primary colon cancers diagnosed and/or treated in the state from 2001-2006. These records were then linked to corresponding OSHPD-PDD records using a probabilistic linking algorithm based on gender, day and date of birth; social security number. After removing the matching variables, the CCR staff then disclosed the data to the investigators.

The CCR contains detailed and specific caner information on all patients diagnosed and/or treated in the state of California for any ICD-O3 defined primary malignancy except non-melanoma skin cancers. The registry is well recognized for the quality, timeliness of reporting and completeness of the data[29]. There are fewer than 3% missing race data and fewer than 2% of the cases are identified through death records. Because reporting of cancer care is required by California, regardless of the modality of treatment, and because of the guidelines governing collection of registry data, the lost-to-follow up rate is low and the CCR is recognized as one of the most complete cancer databases in the US. Variables from the CCR included socio-demographic characteristics (patient age, gender, race/ethnicity, insurance status; census block group SES data and a validated SES composite score[30]); clinical and treatment details (AJCC consolidated stage at diagnosis; receipt and sequence of chemotherapy and surgery; the number of lymph nodes retrieved and examined after surgery); and vital status (survival time in months). The chemotherapy variable in the CCR records responses that indicate if 1 or 2 agents were given; if chemotherapy was recommended but not received; and

if failure to receive chemotherapy was due to 'patient refusal.' Because we are trying to study the impact of the practice of hospitals and health care organizations on outcomes, in cases where chemotherapy was not received due to patient refusal (<2% of cases) records were coded as chemotherapy given, in order to avoid penalizing hospitals for patient preference.

The OSHPD-PDD is state-wide all-payer discharge dataset containing patient level information for each general, acute, non-federal hospital discharge in California. The data set is unique compared to other state databases because there are up to 24 secondary diagnoses recorded with a concomitant variable to indicate whether or not the diagnosis was present at the time of admission. This allows distinction between co-morbidities and hospital acquired conditions. Variables from OSHPD-PDD included primary indication for admission; patient co-morbid disease; ICD9-CM coding for principle procedures performed during the hospitalization; and a unique hospital identification number to indicate where care was delivered. The unique hospital identifier links to an appendix with hospital name, and address.

Integrated health systems were defined in accordance with the executive summary prepared by the Berkeley Forum to Improve California's Healthcare Delivery System[31]. The Forum is a multi-stakeholder group comprised of payers, California health care systems, and faculty from the University of California, Berkeley School of Public Health. By the Forum's definition, a fully integrated system is where, "care is provided by a single entity; whereby one organization is responsible for all services including delivery of care, payment and risk management."[31] According to the Forum, California has only one fully integrated

health system. Hospitals within this system have been identified through their unique hospital identification number in the OSHPD-PDD.

Selection of Patients

We included records for unique adult patients (age ≥ 18 years) with colon cancer, stages I through III, diagnosed and treated in California between the years of 2001 through 2006 (inclusive). Appendiceal and rectal cancers were excluded as the NCCN guidelines for these types of tumors are different than for colon cancer. Records coded as American Indian/Alaskan Native were excluded due to small cell size, in accordance with our data user agreement. Patients treated for isolated metastatic or recurrent disease were not included in the analysis.

Primary Outcomes

For the purposes of the study, we compared the proportions of patients who received evidence based care. Evidence based care was defined as compliance with National Comprehensive Cancer Network (NCCN) guidelines for colon cancer.[32,33] In those cases where patients received 1) surgical resection (ICD9 procedure codes for colectomy—45.8x; 45.7x; 45.8x—for stages I-III); 2) pathologic examination of >12 lymph nodes in the surgical specimen after all resections and 3) appropriate chemotherapy, defined as chemotherapy for patients with node positive (stage III) disease were labelled as compliant with evidence based care. All AJCC consolidated stages were as defined in the CCR. We also compared the risk-adjusted hazard of mortality (HR) associated with care within IHS versus other settings; and racial/ethnic differences in HR within and outside IHS settings.

Data Analysis

Pearson chi-square analysis was used to compare rates of evidence based care.[32,33] The Mantel-Haenszel p-value was used to determine significance of associations for ordinal variables. Records where treatment was recommended but not received for reason that patient refused (1.8% of records) were treated as treatment provided, in order to avoid penalizing hospitals due to patient preferences for care.

Propensity scores matching (PSM) was used to compare survival inside IHS versus other settings. Matching was performed using characteristics known to impact colon cancer survival including: age, gender, race[34], composite socioeconomic status (SES) score[30,35], Deyo-modified Charlson co-morbidity score [36], stage of disease. Using a Greedy 5 to 1 digit matching approach[37] the cases were first matched to controls with the goal of achieving a match of 5 digits of the propensity score. For those that did not match with 5 digits, cases were matched to controls on 4 digits of the propensity score. This continued down to a 1-digit match on propensity score for those that remained unmatched. Among our 6357 matched pairs, 5748 (90.4%) were matched with at least 5-digit accuracy, 292 (4.6%) with 4th digit, 235 (3.7%) at 3rd digit, 76 (1.2%) at 2nd digit, and 6 (0.1%) at 1 digit accuracy. Before and after match plots (see supplemental material) show a result that is very well-balanced and compliant with recommended ranges for standardized mean differences[38,39]. Patient members of the IHS setting have a unique payer which limits care to these settings and is rarely used outside the system. Thus there is no equivalent insurance product outside the system and the

two groups could not be matched on this characteristic. After 1:1 matching of patients inside IHS to those treated outside, we generated PSM-Kaplan Meier survival curves and PSM adjusted Cox proportional hazard models to compare mortality for all patients *between* the two systems.

In order to assess racial/ethnic disparities in each setting, data were first stratified by health care setting (IHS versus other). KM curves for each racial/ethnic group were generated for patients treated in either setting and plotted for comparison against each other. Stratified Cox models predicted hazard of mortality by race within each type of setting. Models were adjusted for the socio-demographic and clinical characteristics listed above, as well as for receipt of compliant care at the patient level. To further strengthen our findings from the stratified models, we built a combined model and included interaction terms for race by location of care.

All tests of significance were two-tailed. Differences were considered significant when the p value was ≤ 0.05 after the Dunnett correction was applied for multiple comparisons on KM curves[40]. Differences in predicted mortality were considered significant when Hazard Ratios (HR) were not equal to 1; and associated 95% confidence intervals (95%CI) excluded 1.

RESULTS

Distribution of patients across settings

There were 348 hospitals and 33,593 unique patient records included in the analysis. Of those hospitals, 44 (13%) facilities were part of the IHS system. Table 1 shows the distribution of patient characteristics across settings. IHS treated 19%

(6,357) of all patients with stage I-III colon cancer, inclusive. The proportion of patients ages 55-74 years was higher in IHS; while the proportion of patients over 85 years was higher in other settings. The proportion of white patients treated outside IHS (71.4%) was higher than inside (66%). The proportion of Hispanic patients was distributed relatively evenly across settings; but there were more black patients treated in IHS (11.9% versus 5.6%). A slightly lower proportion of API populations were treated inside IHS (8.9%) than outside (10.6%). In comparison to other settings, IHS treated more patients with comorbidity scores ≥3 (9.3% versus 7.9%) and a relatively equal distribution of patients by stage. A smaller proportion of low SES patients were treated in the IHS (9.1% versus 12.9%).

Delivery of evidence based care between settings

Figure 1 shows a comparison of the rate of delivery of evidence based care overall and by racial/ethnic group for each setting (significant differences between settings are indicated by *). Overall, IHS provided higher rates of surgery (95.1%) than other settings (92.3%; $p<0.0001$). All racial/ethnic groups had significantly higher rates of surgery in IHS than outside. There was no significant difference in quality of lymph node examination between the two settings. A larger proportion of patients received stage appropriate chemotherapy inside IHS (75.8%) than outside (54.0%; $p<0.0001$). Delivery of appropriate chemotherapy was higher for all racial/ethnic groups treated in IHS versus those treated outside.

Delivery of evidence based care within settings

Figure 1 also shows differences in receipt of evidence based care by race/ethnicity within each care setting. Comparing black to white patients shows that the proportion of black patients undergoing surgical resection was lower than for white patients in both IHS and other settings. The magnitude of difference between these groups inside IHS (-2.2%) was smaller than the gap noted in other systems (-5.8%). There were no differences in receipt of an adequate LN examination or receipt of appropriate chemotherapy between black and white patients in either setting.

For Hispanic patients, the rates of surgery inside IHS were lower than white patients treated in the same setting. This difference was still smaller (-1.5%) than the gap in receipt of surgery between Hispanic and white patients noted in other settings (-2.7%). In the IHS setting, the rate of LN examination was relatively equal between Hispanic and white patients. However, in other settings, there was a lower rate of adequate LN examination for Hispanic compared to white patients (-4.2%). There was a higher rate of stage-appropriate chemotherapy delivered to Hispanic over white patients in both settings, but the magnitude of the advantage was higher in IHS (+7.8% versus +5.3%).

For API patients, there were no notable differences in the receipt of surgery when compared to white patients in either setting. There was a lower rate of receiving an adequate LN examination inside IHS (-5.2%), a larger gap than found in other settings (-2.8%). While there was a higher rate of chemotherapy delivered to API compared to white patients in both settings, the advantage was larger in IHS (+10.9%) than outside (+5.4%).

Survival across healthcare settings

Figure 2 upper and lower panels show the results of propensity score matched (PSM) comparisons of mortality inside and outside IHS. All of the 6,357 patients treated in IHS were well-matched to patients in other settings (details shown in supplemental material). In the upper panel of figure 2, PSM Kaplan-Meier survival curves show improved survival in the aggregated group of patients treated in the IHS setting (log rank $p<0.0001$). In the lower panel, PSM-Cox models predict the hazard of mortality associated with integrated system as compared to other settings. The models show a 15% survival advantage ($p<0.001$) for early stage (stage I & II) disease, and an 8% survival advantage for stage III disease ($p<0.001$). For all stages, there was protective association between care in the integrated system and mortality for all 3 stages [HR 0.87; (95%CI 0.85-0.90)].

Racial/ethnic group survival and disparities across settings

Figures 3a and b show the side-by-side comparison of KM survival curves for each minority group, stratified by health care setting. For black patients treated within the integrated settings, there was an unadjusted survival advantage over white patients ($p>0.001$). This contrasts with patients treated in non-IHS where there was a significant disparity in survival for black compared to white patients ($p=0.02$). There was an unadjusted survival advantage for Hispanics and API groups compared to whites in both settings ($p<0.001$ for all comparisons).

Table 2 shows Cox models, stratified by care setting and estimating the hazard of mortality for each racial group, after adjustment for demographic and clinical factors (Model 1); and subsequently adjusted for receipt of evidence base

care (Model 2). In the first model, we found no significant survival disparity for racial groups compared with white patients treated in the integrated setting (p>0.12 for all comparisons). By contrast, in other settings, there was a 15% increase in the hazard of mortality for black versus white patients (p=0.007). There was a survival advantage for both Hispanic (HR 0.87; 95%CI 0.80-0.95) and API (HR 0.74; 95%CI 0.68-0.81) patients in other settings In model 2, adjusting for receipt of NCCN guideline based care, revealed a survival advantage for black (HR 0.79; 95%CI 0.65-0.96) and API (HR 0.79; 95%CI 0.64-1.00) groups treated in the IHS setting. Adjustment for receipt of high quality care improved outcomes for all groups in other settings, neutralizing the disparity between blacks in whites; and slightly increasing the survival advantage for Hispanic and API groups. A combined model estimating mortality in both settings was also built and adjusted for the potential interaction between race and location of care. The results of the combined model (supplemental to table 2) show no disparity for Hispanic and API patients treated in IHS and a survival advantage for black patients treated in this setting. Adjustment for evidence based care further increased the advantage for blacks treated in IHS, supporting the findings in the stratified model.

DISCUSSION

The purpose of the current investigation was to determine the association between colon cancer care in an integrated system (IHS) and receipt of evidence based care, overall survival and disparities. We found that the IHS had higher rates of delivering NCCN guideline based care to all populations. There were significant differences in the rate of surgical resection and delivery of chemotherapy, but no

difference in the rate of lymph node examination between settings. Minorities in these systems received higher rates of evidence based care than those treated outside; and the gaps in receipt of quality care between racial/ethnic groups within the integrated system were generally smaller than those outside. PSM mortality models showed an overall survival advantage associated with care in IHS. The IHS associated advantage was observed across stage. There were no racial/ethnic disparities in survival noted within the IHS. Receipt of evidence based care improved survival for all racial/ethnic groups, but was importantly associated with a survival advantage for black patients in IHS and appeared to neutralize disparities in other settings.

The results of our study contrast with those who have previously shown no difference in cancer care or outcomes when comparing Medicare patients enrolled in a Health Maintenance Organizational to those outside[41]. The difference between the prior study and ours is likely related to the homogeneity of the sample (by age and insurance status) in the former. This may have limited the ability to detect differences. By capturing all age, all payer data from a racially and ethnically diverse population based dataset, and combining it with robust PSM and detailed patient risk adjustment, we are able to make comparisons both across multiple racial/ethnic groups *and* between settings. We even included a validated SES composite score to address the issues of selection based on inclusion in the IHS network. Thus, our results should advance the understanding beyond previously published studies about the impact of health care setting on quality of care, and disparities.

Our results are in line with others who have found variation in adherence to evidence based guidelines in association with hospital structural characteristics[19,27,28,42,43]. In these studies, hospital characteristics which might suggest a lack of resources or low volume were correlated with poor performance on guideline driven care for benign[42,43] and malignant diseases[19,27,28]. The current findings also support other published literature correlating hospital characteristics with disparities and overall cancer survival[7,15,18]. Donabedian's health care quality triad[44] gives face validity to the idea that location of care can impact on outcomes. In the triad, structural quality (IHS or not) can influence both process quality (NCCN guideline adherence) and outcome quality (survival and disparities). In our study, treatment in IHS was associated with higher rates of guideline adherence, and not surprisingly, improved survival. We also found that gaps in evidence based care were smaller or favored minority populations in IHS. The hazard of mortality for minorities was also lower inside the integrated system than outside. Our results suggest that IHS may provide a model for improving the delivery of cancer care and addressing racial/ethnic disparities.

Despite similarities to other work, this investigation is quite novel. Although there are other studies evaluating the health effects of integrated health systems[24,26,45 46], the majority are limited to analysis of cancer survival and/or disparities within a select system. There is only one published study comparing process quality in the index system to another system outside of itself[25]. To our knowledge, we are the first to compare process quality, outcome quality, and disparities between systems in a single investigation. We are also the first to use validated socioeconomic status (SES) measures in the analysis. Since membership

in IHS may be a marker for socioeconomic class (must be employed or able to afford membership) which may correlate with survival, inclusion of these factors is critical to the validity of our findings. Another important aspect of the work is that disparities between black and white patients outside the system were neutralized after accounting for delivery of evidence based care. The results are therefore quite robust and important because they bolster the assertion that the provision of equitable, high quality care may serve as a powerful driver in eliminating cancer disparities.

One potential explanation for our findings relates to the complexity of treating cancer[47,48] and the potential advantage of a highly networked system of delivery. High quality cancer care requires coordination of services between multi-disciplinary providers who may not work in the same physical facility. Theoretically, members of the IHS (patients) receive each step in cancer care (surgery and adjuvant therapy) within the system. When cancer treatment occurs outside the system, patients having surgery in one hospital may obtain adjuvant therapy elsewhere, with no obligatory coordination of care. The unintended consequences are fragmentation, failed hand-offs, lapses in treatment and loss to follow up[49-51]. Our findings suggest that integrated systems may be well equipped to provide high quality care for diseases requiring coordination of care between multidisciplinary providers. Our results also suggest that Accountable Care Organizations as envisioned in the Affordable Care Act may play a critical role in improving cancer survival and eliminating cancer disparities through systems coordination and integration.

LIMITATIONS

This study has some limitations. First, it is based on cross sectional, administrative data, thus, we cannot show causation. Nonetheless, we can and do convincingly argue that the care delivered in IHS is more highly compliant with guidelines than in other settings. Moreover, our results show a strong association between the use of the IHS setting and improved survival. This is consistent with previous work which has shown that NCCN guideline compliance supports better outcomes in cancer[27,46,52]. Our use of a PSM to address issues of patient selection strengthens our results. Thus, despite the limitation of performing retrospective analysis on administrative data, our study has uncovered important insights on the potential for IHS to positively influence cancer survival and disparities.

We are also limited by some of the nuances missing from administrative data. For example, although we can distinguish patients who have refused chemotherapy from those who did not receive it as a result of physician or system failure, there are no variables in the CCR to determine that the temporal delivery of chemotherapy (i.e. within 4 months) was compliant with guidelines.

CONCLUSIONS

Because IHS approach to care is associated with higher levels of evidence based medicine, improved survival and amelioration of colon cancer disparities, it may represent an important model for improving cancer outcomes. In addition, health care systems outside the IHS may consider developing programs to increase the delivery of evidence based care for colon cancer in order to address disparities. Future work should repeat this investigation in other types of cancers. If use of IHS

is associated with higher adherence to evidence based guidelines and/or survival advantages in other malignancies, the results could guide the development of emerging ACO’s under health care reform.

Acknowledgements

Dr. Rhoads and Mr. Ma had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the analysis. None of the authors have any financial interests, activities or relationships relevant to the content of the investigation; therefore there are no conflicts of interest to report. Dr. Rhoads work on this project was supported by a grant from the National Cancer Institute (1R21CA161786-01A1) and a Harold Amos Medical Faculty Development award from the Robert Wood Johnson Foundation, Princeton, New Jersey. There are no relevant financial interests, activities, relationships, affiliations or other conflicts of interest to report for any of the manuscript authors.

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