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Better Colon Cancer Care for Extremely Poor Canadian Women Compared with American Women

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Extremely poor Canadian women were recently observed to be largely advantaged on most aspects of breast cancer care as compared with similarly poor, but much less adequately insured, women in the United States. This historical study systematically replicated the protective effects of single- versus multipayer health care by comparing colon cancer care among cohorts of extremely poor women in California and Ontario between 1996 and 2011. The Canadian women were again observed to have been largely advantaged. They were more likely to have received indicated surgery and chemotherapy, and their wait times for care were significantly shorter. Consequently, the Canadian women were much more likely to experience longer survival times. Regression analyses indicated that health insurance nearly completely explained the Canadian advantages. Implications for contemporary and future reforms of U.S. health care are discussed.

KEY WORDS: *colon cancer; health care reform; health insurance; poverty; single-payer system*

Both the poor and the uninsured populations of the United States rose to approximately 50 million during the Great Recession of 2007 to 2011 (DeNavas-Walt, Proctor, & Smith, 2012). In concert with presidential advocacy, these social forces seemed critical in enabling passage of the Patient Protection and Affordable Care Act, so-called Obamacare, in 2010. Although Obamacare is bound to make health care more accessible for millions of Americans, it does not guarantee care for all. In fact, the Congressional Budget Office (2012) estimated that it will leave 25 million Americans uninsured and millions more underinsured. Canada seems of particular comparative interest. Its poverty rate did not increase during the Great Recession (Murphy, Zhang, & Dionne, 2012), and all Canadians are insured for medically necessary care by a single, public payer.

NASW (2009) in coalition with others (Healthcare-Now, 2013), has long advocated for single-payer reform of U.S. health care, and their advocacy on behalf of the uninsured continues. Debates about the difference Obamacare is likely to make compared with the difference that might be realized by single-payer reform also continue. We think that historical comparative studies of U.S. and Canadian health care can begin to resolve these debates. This study aims to advance such knowledge by examining evidence on a telling health care indicator among key informative populations: colon cancer care among women who lived in the poorest neighborhoods of America or Canada before Obamacare.

EXTREMELY POOR NEIGHBORHOODS IN THE UNITED STATES AND CANADA

Four of every 100 Americans live in extremely poor neighborhoods where 30 percent to 40 percent or more of the people are poor. Places of prevalent vulnerability, they are particularly distressed as a result of their lack of social and economic capital (Jargowsky, 2005; Kawachi, 1999; Wilson, 2012). Adequate health insurance (HI) is also commonly lacking among those who live in the poorest of America's neighborhoods, especially those who may need it the most, such as those with illnesses like colon cancer that can require very costly care (Gorey et al., 2012; Shankaran, Jolly, Blough, & Ramsey, 2012). Less is known about high-poverty neighborhoods in Canada, not surprisingly, as they are less prevalent and seem to be less deeply poor places than in the United States (Chen, Myles, &

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Picot, 2012). They do exist though. In fact, two of every 100 Ontarians live in very poor neighborhoods (Gorey, 1998; Statistics Canada, 2002). Though the cancer risks that Canadians are exposed to there are probably similar to those of their U.S. counterparts (Gorey, Holowaty, Laukkanen, Fehringer, & Richter, 1998; Krieger et al., 2002), they have one distinct advantage: All enjoy access to health care. Therefore, comparisons between Canada and the United States with regard to colon cancer care among the poor may help to clarify any disadvantaging effects of being uninsured or underinsured in America.

COLON CANCER CARE IN POOR U.S. AND CANADIAN NEIGHBORHOODS

Colon cancer care seems a sentinel health care performance indicator. The second most common cause of cancer death in North America, its prognosis can be good with early diagnosis and treatment (Canadian Cancer Society, 2009; Edwards et al., 2010). And it may be particularly instructive for Canada–U.S. comparisons among women for these reasons. First, low-income status has been consistently observed to be inversely associated with colon cancer care in the United States, but not in Canada (Gorey, Luginaah, Bartfay, Fung, Holowaty, Wright, Hamm, & Kanjeekal, 2011; Booth, Zhang-Salomons, & Mackillop, 2010; Etzioni, El-Khoueiry, & Beart, 2008; Lima, Yasui, Scarfe, & Winget, 2011; Rayson, Urquhart, Cox, Grunfeld, & Porter, 2012). Second, in the United States, people with private HI or Medicare coverage are more likely to receive the best, evidence-based care and to survive longer than are those with arguably less adequate Medicaid coverage or no coverage (Boland et al., 2013; Bradley, Given, Dahman, & Fitzgerald, 2008). Third, being poor, uninsured or Medicaid insured are all much more common among women than men in the United States (Gorey et al., 2012; DeNavas-Walt et al., 2012; Iceland, 2013). And fourth, HI has recently been found to substantially buffer the disadvantaging effects of poverty on colon cancer treatment and survival among women, but not men, in California (Gorey et al., 2012). Colon cancer care seems quite sensitive to the sorts of social policy forces that probably determine much of the income and HI inequities, particularly among women, in North America.

Extremely poor Canadian women were recently observed to be largely advantaged on most aspects of breast cancer care as compared with similarly poor, but much less adequately insured, women in the United States (Gorey et al., 2013). We are unaware of any study that compared colon cancer care between extremely poor Canadian and American women. This systematic replicating study does so. Hypotheses were as follows: Canadian women with colon cancer who live in high-poverty neighborhoods will be advantaged on evidence-based care and survival compared with their U.S. counterparts, advantages for Canadians will be greater when compared with inadequately insured Americans (uninsured or Medicaid insured), and advantages among Canadians will be mediated or explained by the intermediate effect of their all having HI.

METHOD

Sampling the Historical Cohorts

This study's sampling frame combined Ontario and California cancer registries (OCR, CCR), which comprehensively and validly monitor the most populous Canadian province and U.S. state (Gorey, Luginaah, Bartfay, Fung, Holowaty, Wright, Hamm, & Kanjeekal, 2011). It secondarily analyzed the high-poverty strata of a California–Ontario colon cancer database that originally included high-, middle-, and low-poverty neighborhoods. Women with colon cancer were randomly selected between 1996 and 2000 from three geographic strata in Ontario and California: large urban areas, smaller urban areas, and rural areas. They were followed until 2011. Data were collected on stage of disease at diagnosis and treatments from health records to augment the OCR. Given the costs, we sampled 300 women from high-poverty neighborhoods in Ontario. We oversampled 1,000 women from such neighborhoods in California. Oversampling costs were negligible as all study variables were routinely coded by the CCR. The California participants served as multiple "controls" for the Ontario participant "cases" in a ratio of 3 to 1. This study was powered (80 percent) to detect rate differences of 10 percent at a significance of 5 percent (Fleiss, Levin, & Paik, 2003; Hennessy, Bilker, Berlin, & Strom, 1999).

High-Poverty Cohort Definitions

Similar definitions of poverty are used by Statistics Canada and the U.S. Census Bureau, but the U.S. threshold is more severe (Osberg, 2000). After linking women with colon cancer in California to the

2000 census according to their residential census tract (CT), a sample was randomly selected from CTs in which 30 percent or more of the households met the federal poverty criterion (range = 30.0 percent to 100 percent, median = 36.8 percent; U.S. Census Bureau, 2002). A sample was similarly selected from the poorest Ontario CTs (range = 15.0 percent to 52.8 percent, median = 22.7 percent; Statistics Canada, 2002). The median annual household incomes in U.S. dollars (Bank of Canada, 2013) were similar for the California ($22,875) and Ontario ($22,175) cohorts.

Cancer Registry Variables

Variables coded by the CCR or by our research team to augment the OCR were stage of disease at diagnosis (localized stage I to metastasized stage IV), receipt of surgery and chemotherapy, number of regional lymph nodes harvested, wait times from diagnosis to surgery and from surgery to chemotherapy, and survival time. Stage, treatment, and survival variables all had less than 3 percent missing data. Agreements were high among three health record technicians who collected the augmenting data in Ontario. Interrater assessments of 50 randomly sampled health records found κ coefficients of 0.88 to 0.96 across variables. In California, primary HI status was uninsured (11.6 percent), Medicaid (15.0 percent), Medicare (32.1 percent), or private (41.3 percent). Given our oversampling of poor neighborhoods, the low representation of the uninsured may seem surprising. Note that colon cancer care typically takes place in hospitals where social workers, in addition to their provision of psychosocial support, information, referral, coordination, and advocacy services throughout cancer treatment and follow-up, work to connect uninsured people to any additional resources such as Medicaid or Medicare for which they may be qualified.

Statistical Analyses

Clinical practice guidelines of the American Society of Clinical Oncology and Cancer Care Ontario were used in comparing treatment rates between the two cohorts (Benson et al., 2004; Jonker, Spithoff, Maroun, & Gastrointestinal Cancer Disease Site Group, 2008). Rates were directly adjusted for age and tumor grade and reported as percentages. Then standardized rate ratios (RRs) were reported for between-country comparisons, with 95 percent confidence intervals (CI) derived from the chi-square test. Logistic regression models tested hypotheses about mediating effects of HI on country–survival relationships. We estimated odds ratios (*OR*s) and 95 percent CIs and imputed missing data from full models. Binary survival outcomes (survived a certain number of years or not) that were best predicted were reported (Hosmer & Lemeshow, 2000). We ran logistic regression models that included the following predictors: country alone; country and HI; country, HI, and disease stage; and country, HI, stage, and treatments. These, respectively, assessed the significance of Canadian advantages; their mediation by HI; and the main and mediating effects of diagnoses, investigations, and treatments. This study was reviewed and cleared by the University of Windsor research ethics board. Other methodological details have been reported (Gorey, Luginaah, Bartfay, Fung, Holowaty, Wright, Hamm, & Kanjeekal, 2011, Gorey, Luginaah, Bartfay, Fung, Holowaty, Wright, Hamm, Kanjeekal, & Balagurusamy, 2011, Gorey et al., 2012, 2013).

RESULTS

Description of Canadian Colon Cancer Care Advantages

Survival Rates. Comparisons of survival rates between the cohorts of women with colon cancer in high-poverty neighborhoods of California and Ontario are displayed at the top of Table 1. Overall seven-year survival rates were significantly greater in Ontario (RR = 1.16), and as hypothesized, this advantage was much greater when compared with overall survival among uninsured or Medicaid insured women in California (RR = 1.45). In fact, the women with colon cancer in Ontario (44.6 percent) were nearly 50 percent more likely to survive than were their inadequately insured counterparts in California (30.7 percent). A cancer-specific survival analysis revealed a very similar Canadian advantage (RR = 1.46; 95 percent CI, 1.12, 1.90; data not shown). Anecdotally, we found no significant between-country survival differences among men in this study's preliminary design phase.

Diagnoses and Treatments. The women in California and Ontario were equally unlikely to have been diagnosed early. Their rates of stage I disease at diagnosis were 21.6 percent and 20.7 percent, respectively (RR = 0.96; 95 percent CI, 0.75, 1.22). Overall, there was not a between-country

Table 1: Significant Differences between Female Residents of California and Ontario's Poorest Neighborhoods: Rates and Standardized Rate Ratios

	California		Ontario		Ontario/ California	
Care Characteristic and Primary Insurer	**Sample**	**Rate[a]**	**Sample**	**Rate[a]**	**RR**	**95% CI**
Overall seven-year survival	975	38.4	289	44.6	**1.16**	1.00, 1.35
Private or Medicare	802	39.8			1.12	0.96, 1.30
Uninsured or Medicaid	173	30.7			**1.45**	1.14, 1.85
Stage II or III disease						
Had surgical resection	569	97.2	164	97.6	1.00	0.97, 1.03
Any insurance	525	97.3			1.00	0.97, 1.04
Uninsured					**1.07**	1.00, 1.14
Stage III disease						
Received chemotherapy	241	43.6	78	45.1	1.03	0.83, 1.28
Private or Medicare	187	44.0			1.02	0.88, 1.18
Uninsured or Medicaid	54	30.2			**1.49**	1.00, 2.25
Received chemotherapy for stage II or III disease						
60+ days wait postsurgery	229	37.7	55	20.0	**0.53**	0.32, 0.88
Private or Medicare	172	32.3			0.62	0.36, 1.07
Uninsured or Medicaid	57	59.8			**0.33**	.20, 0.55

Notes: Bolded RRs are statistically significant. Rates were adjusted for age and tumor grade. RR = rate ratio; CI = confidence interval.
[a]Adjusted rates per 100 reported as percentages.

difference on the receipt of surgical resection, which was received in nearly all instances for which it was indicated. However, 7 percent fewer of the uninsured women in California received surgical treatment of their colon cancers (RR = 1.07). Of course, there are legitimate reasons for refusing surgery. But the overall surgery refusal rate of 14.8 percent among the very few women who did not have surgery did not differ significantly between countries [$\chi^2(1, N = 27) = 0.37$, p = not statistically significant].

Adjuvant chemotherapy, typically indicated after surgery for people with stage III disease to further assist in the elimination of cancer cells, is displayed next in Table 1. There was no overall difference between the cohorts. However, the Ontario chemotherapy rate (45.1 percent) was nearly 50 percent greater than the rate among the uninsured or Medicaid insured in California (30.2 percent, RR = 1.49). Chemotherapy for stage II colon cancer, experimental at the time of this study, was not associated with country. It was not commonly received by poor women in California (18.4 percent) or Ontario (18.2 percent; RR = 0.99; 95 percent CI, 0.90, 1.09).

Various long wait times for treatment may be associated with colon cancer recurrences, metastases, or shorter survival. An exemplary one is displayed at the bottom of Table 1. Overall, the women in Ontario were less likely than the women in California to have waited two months or more between their surgery and receipt of adjuvant chemotherapy (20.0 percent versus 37.7 percent, RR = 0.53). As hypothesized, adequately insured women in California did not differ significantly from Ontario women with regard to long waits, but the inadequately insured in California were much more likely to experience them (59.8 percent, RR = 0.33). The women in California (10.7 percent) and Ontario (11.2 percent) were equally unlikely to have experienced waits of a month or more for surgery (RR = 1.05; 95 percent CI, 0.45, 2.43).

Canadian Advantages Explained by HI

Two distinct, practically significant survival analyses are displayed in Table 2: (1) 10-year survival among women with nonmetastasized disease and (2) eight-year survival among women with nonlocalized and nonmetastasized disease. Such treatable colon cancers tend to entail the most clinical and managerial discretion. In both instances, model 1 demonstrated significant Canadian survival advantages (respective *OR*s of 1.48 and 1.38) that, as hypothesized, were mediated by the positive effects of having adequate health insurance in model 2 (respective *OR*s of 1.72 and 1.75). Significant main effects of early diagnosis (model 3), thorough lymph node evaluation, and treatment access (model 4) were entered into regressions in

Table 2: Associations of Characteristics with Long-Term Survival among Women Less than 80 Years of Age with Treatable Colon Cancers: Logistic Regression Models

	Model 1		Model 2		Model 3		Model 4	
Characteristic	***OR***	**95% CI**	***OR***	**95% CI**	***OR***	**95% CI**	***OR***	**95% CI**
	10-Year Survival among 687 Women with Nonmetastasized Disease							
Country (Canadian advantage)	**1.48**	1.02, 2.16	1.31	0.89, 1.94	1.27	0.85, 1.89	1.18	0.77, 1.83
Medicare or private insurance			**1.72**	1.09, 2.69	**1.88**	1.18, 2.98	**1.81**	1.12, 2.90
Stage I disease at diagnosis					**2.91**	1.96, 4.33	**2.94**	1.95, 4.41
16 or more lymph nodes harvested							**1.59**	1.02, 2.48
	Eight-Year Survival among 506 Women with Stage II or III Disease at Diagnosis							
Country (Canadian advantage)	**1.38**	1.00, 1.90	1.24	0.78, 1.96	1.34	0.84, 2.15	1.35	0.86, 2.15
Any insurance			**1.75**	1.01, 3.03	**2.16**	1.06, 4.41	**2.23**	1.10, 4.55
Stage II disease at diagnosis					**2.02**	1.39, 2.95	**2.24**	1.50, 3.36
Received chemotherapy							**1.39**	1.01, 2.19

Notes: All effects were adjusted for age, tumor grade and place (large or small, urban or rural). Bolded odds ratios (*OR*s) are statistically significant. The findings of overall (all-cause) and cancer-specific survival analyses were nearly identical. Overall survival analyses are presented in the table. CI = confidence interval. Surgical and chemotherapy treatment rates were significantly lower among participants 80 years of age or older in both countries.

temporal order. Early diagnosis and more thorough lymph node evaluation each strongly predicted 10-year survival. These diagnostic and investigative effects seemed to be similar in both countries as there were no significant Stage × Country or Investigation × Country interactions. A similar pattern was observed for the prediction of eight-year survival by early diagnosis and chemotherapy receipt. We also analyzed predictors of three-year survival among 260 women with metastasized disease (data not shown). Neither country nor health insurers were predictive. Only palliative chemotherapy receipt entered the regression model ($OR = 3.95$; 95 percent CI, 1.37, 11.36) and predicted survival.

DISCUSSION

Using colon cancer care as a policy indicator, we found modest support for our hypothesis that, overall, extremely poor Canadian women were advantaged in the years before Obamacare. They were slightly more likely than their U.S. counterparts to enjoy relatively long survival of up to seven years after their diagnosis. However, we found strong and consistent support for our hypothesis that advantages among extremely poor Canadian women would be greater when compared with inadequately insured Americans. Extremely poor Canadian women seemed largely advantaged across the colon cancer care continuum. They were much more likely to receive chemotherapy when it was most indicated, and they were much more likely to survive longer than inadequately insured Americans. Contrary to contemporary political rhetoric, the Canadian women were even much less likely than the American women to experience long waits for care.

There were some null findings. No between-country differences were observed for stage of disease at diagnosis or for the receipt of chemotherapy for stage II disease. Even these null findings seemed to provide discriminant validation of the theory that HI adequacy explains the observed Canadian advantages. Study participants were diagnosed during the 1990s. At that time, colon cancer screening had only begun to proliferate. Respectively, less than one in four or five eligible Californians or Ontarians were screened for colon cancer during that time (Ganz et al., 2005; Rabeneck & Paszat, 2004). Similarly, chemotherapy for stage II colon cancer was experimental at that time. Consequently, HI gradients or Canada–United States differences on these aspects of colon cancer care were not expected nor observed. Finally, our third hypothesis was validated by two mathematical models of relatively long-term survival of treatable colon cancer. Both models supported our hypothesis that HI mediates between-country differences in colon cancer survival. Survival advantages among Canadian women were largely explained by their much better HI coverage.

Population Significance of Health Care Policy

This study's key between-country differences estimated with standardized RRs or adjusted *OR*s converged at about 1.50. They clearly indicated large advantages for Canadians compared with inadequately insured Americans. But attributions of risks

or preventive potentials at the population level are functions of three factors of which the magnitude of the between-group difference is only 1. It is also important to consider the size of the population at risk as well as the prevalence of exposures to the risk or protective factors being studied. In this instance, the central exposure or risk factor to be mediated is a social one, poverty. The other social exposure of interest is the risk of being inadequately insured. Nearly 70,000 American women are diagnosed with colon cancer each year (U.S. Cancer Statistics Working Group, 2010), and regrettably, they remain very commonly exposed to poverty and HI inadequacy. Applying this study's effects to these parameters, it can be straightforwardly estimated (Greenland, 2008) that tens of thousands more of the American women received suboptimum treatment and died prematurely during this study's 15-year time span than probably would have if they had enjoyed access to a single-payer system of health care like Canada's. Obamacare will surely begin to close such between-country care gaps. However, given the substantial inadequately insured population that will probably remain in America (CBO, 2012), some care and survival gaps are likely to remain. This study strongly suggests that single-payer reform of U.S. health care would serve to further close such gaps.

Potential Limitations

One may wonder if the ethnic compositions of high-poverty neighborhoods, rather than their concentrations of the poor, accounted for the observed colon cancer care inequities. We think not, for these reasons. First, although the OCR does not code ethnicity, key findings were replicable by conservatively comparing the subsample of non-Hispanic white women in California with the entire ethnically diverse sample in Ontario. For example, the large Canadian advantage on chemotherapy receipt remained even when we excluded all members of any ethnic minority group that comprised more than half of the California sample: non-Hispanic African (23.3 percent), Hispanic (23.7 percent), and Asian or Pacific Islander Americans (9.2 percent). And the substantial rate of suboptimum chemotherapy among inadequately insured women of color in California did not differ significantly from that of their non-Hispanic white counterparts. The disadvantaging effects of being inadequately insured seem quite similar for all poor American women with colon cancer, whether they are majority white or minority women of color. Ethnicity seems clearly not to confound this study's findings about colon cancer care among the poor of Canada and the United States.

Does this mean that ethnicity or race does not matter? It unequivocally does not. Recall that a population's risk is a function not only of effect magnitude, but also of the size of the population at risk and the prevalence of its exposure to risks. Women of color comprised more than half of the sample of the poor women with colon cancer in California, and compared with non-Hispanic white women, they were more than twice as likely to be uninsured or Medicaid insured (27.8 percent versus 13.1 percent). This suggests that, in California and other diverse U.S. states, six to seven out of every 10 of the suboptimum treatment plans and premature deaths due to colon cancer among poor women are experienced by women of color (Galea, Tracy, Hoggatt, DiMaggio, & Karpati, 2011; Steenland & Armstrong, 2006). Although the disadvantaging effects of being inadequately insured are similar for all poor American women, because women of color are both more likely to be poor and inadequately insured, they are much more likely than non-Hispanic white women to experience the injustices of contemporary U.S. health care. Race still matters in U.S. health care (West, 1993).

The cancer registries studied did not code comorbid conditions, but they did code causes of death. As a result, this study's analyses did not directly account for potential confounding by comorbidities that are well known to be associated with both socioeconomic factors and mortality (Etzioni et al., 2008). But they did indirectly account for them. Recall that overall survival analyses were replicated with cancer-specific analyses that accounted for competing causes of death such as those primarily caused by comorbid heart, lower respiratory, and cerebrovascular diseases. In addition, Canadian and American women with similar disease stages were compared and through mathematical modeling, essentially matched on a proxy of cancer virulence; tumor grade; and a correlate of other chronic diseases, age. Therefore, the two groups seemed to be quite similarly diseased, making comorbid alternative explanations unlikely.

This study could also be limited by incomplete information on chemotherapy. Because chemotherapy is most often received in an outpatient setting, it

can be more challenging for cancer registries to survey. For the following reasons, we think that incomplete information on chemotherapy or missing chemotherapy data is not a potent alternative explanation. First, the CCR data on chemotherapy were demonstrated to be mostly complete (81 percent to 84 percent across regions) during the time that this study's participants were being treated, and errors have been demonstrated not to differ by income (Cress et al., 2003; Mallin et al., 2013). Second, missing chemotherapy data were infrequent and did not differ between this study's Ontario and California cohorts. Third, analyses of insurers, hospital-based surgeries, and survival were unlikely to have been affected (Chan, Gomez, O'Malley, Perkins, & Clark, 2006; Hall, Schulze, Groome, Mackillop, & Holowaty, 2006; Li, King, deGara, White, & Winget, 2012; Mallin et al., 2013; Verrill, 2010), and any modest errors very likely did not differ by socioeconomic factors (Chan et al., 2006). Such modest nondifferential errors on exposures, mediators, or outcomes suggest that any bias of findings would probably have been toward the null (Blakely, McKenzie, & Carter, 2013; Copeland, Checkoway, McMichael, & Holbrook, 1977; Jurek, Greenland, & Maldonado, 2008). That is, the magnitude of this study's observed Canadian advantages on colon cancer care and survival, as well as their mediation by HI, may all be slight underestimates.

CONCLUSION

Extremely poor women with colon cancer receive much better care and are much more likely to survive in Canada than in the United States. Prevalent HI inadequacies in America versus universal, single-payer coverage in Canada largely explain this between-county divide. Obamacare will probably substantially reduce such inequities, but single-payer reform would probably further reduce if not completely eliminate them. HSW

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