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Breast Cancer Care in California and Ontario: Primary Care Protections Greatest Among the Most Socioeconomically Vulnerable Women Living in the Most Underserved Places

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Guangyong Zou², and Eric J. Holowaty³

Abstract

Background: Better health care among Canada's socioeconomically vulnerable versus America's has not been fully explained. We examined the effects of poverty, health insurance and the supply of primary care physicians on breast cancer care. **Methods:** We analyzed breast cancer data in Ontario ($n = 950$) and California ($n = 6300$) between 1996 and 2000 and followed until 2014. We obtained socioeconomic data from censuses, oversampling the poor. We obtained data on the supply of physicians, primary care and specialists. The optimal care criterion was being diagnosed early with node negative disease and received breast conserving surgery followed by adjuvant radiation therapy. **Results:** Women in Ontario received more optimal care in communities well supplied by primary care physicians. They were particularly advantaged in the most disadvantaged places: high poverty neighborhoods (rate ratio = 1.65) and communities lacking specialist physicians (rate ratio = 1.33). Canadian advantages were explained by better health insurance coverage and greater primary care access. **Conclusions:** Policy makers ought to ensure that the newly insured are adequately insured. The Medicaid program should be expanded, as intended, across all 50 states. Strengthening America's system of primary care will probably be the best way to ensure that the Affordable Care Act's full benefits are realized.

Keywords

primary care, supply of physicians, poverty, health insurance, breast cancer, health care policy, health care reform, Patient Protection and Affordable Care Act

Introduction

Neighboring nations naturally wonder whose policies affect better health. Health policy has been a consistent wonderment between Canada and the United States. They share a long border and many socioeconomic characteristics, but provide health care in distinct ways. Canada provides care via a single, public payer, while the United States does so with multiple private and public payers. Prior to the Affordable Care Act (ACA) nearly 100 million Americans were inadequately insured.¹⁻³

Pre-ACA Canada-US studies had inconsistent findings.⁴⁻⁷ Subjective health was better among Canadians and disease incidence and survival differences favored Canadians. Outcomes favoring Americans were small.⁸ However, such comparisons of national “haystacks” probably lost important “needles” of knowledge. Consider the

diversity of Canada and the United States: uninsured to well-insured, residents of megalopolises to remote places, the poor to affluent, and so on. Studies of average country effects are certain to lose knowledge about important sub-populations. Studies of cancer care in impoverished places observed large Canadian advantages.⁹⁻¹³ The poorer the places the larger their advantages.^{14,15}

A meta-analysis of 78 breast cancer survival outcomes across all 50 states and 2 provinces, Ontario and Manitoba,

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between 1985 and 2005 found large Canadian advantages in low-income places (aggregate survival rate ratio of 14%), but no practically significant between-country differences in middle- or high-income places.¹⁶ More recently, in the poorest neighborhoods of California and Ontario, the risk of breast cancer–related death differed by 19%, health insurance accounting for much of the Canadian advantage.^{9,17} These same studies also observed better access to surgical and adjuvant treatments among women living in poverty with breast cancer in Canada than among similarly impoverished women in the United States. In contrast with common wisdom and much political rhetoric, the Canadian women even experienced shorter waits for care. Focusing on the socioeconomically vulnerable clearly seems to magnify human and policy significance.

The late Barbara Starfield suggested that “insurance is not sufficient” to explain Canada’s advantages.^{16,18} She theorized that Canada’s primary care-orientation is significantly protective. Pre-ACA, primary care physicians (PCPs) were much more prevalent in the Canadian physician workforce (47% vs 27%) and PCP supply was more strongly associated with cancer care in Ontario than in California.^{19,20} Increased specialist supplies may diminish public health, but studies have been inconsistent.^{21–25} We are not aware of any Canada-US study of breast cancer care that observed the effects of poverty, health insurance and physician supplies, PCPs and specialists. This controlled historical study does so. Its focus on the socioeconomically vulnerable provides a relatively less confounded between-country comparison and a more policy-important one.

Methods

Samples

We oversampled socioeconomically vulnerable women diagnosed with breast cancer in Ontario and California between 1996 and 2000 and followed them until 2014. Sensitive to socioeconomic forces, breast cancer care is a quality sentinel, useful for comparing health systems.²⁶ Ontario and California, the most populous province and state, have high-quality cancer surveillance systems.^{27–30} Primary health insurance payers were defined in California as private (53.6%), Medicare (28.2%), Medicaid (7.4%), or uninsured (10.8%).

Ontario and California cancer registries do not gather personal income data so we joined them to neighborhood data via Canada (2001) and United States (2000) census tracts.^{31,32} They use similar definitions of economic deprivation. Both are based on household income, but the Canadian low-income cutoff is more liberal.³³ Our experience suggested that they could be used to construct similar high-poverty cohorts in California and Ontario. One-third of participants in California were randomly selected from

high-poverty neighborhoods where 30% or more had incomes below the federal criterion.^{34–36} Remaining California participants were randomly selected from lower poverty neighborhoods; a third more each from middle (5%–29% poor) and higher income neighborhood strata (<5% poor). We then explored Ontario poverty criteria to minimizing the between-country difference in high poverty neighborhoods and maximizing within-country differences between high- and lower poverty neighborhoods. That best criterion was 25%. We then similarly selected from these poorest and less poor Ontario neighborhoods.³¹

Four of every 100 Californians and 2 of every 100 Ontarians live in high-poverty neighborhoods.^{31,34–38} Median incomes in these neighborhoods were quite similar (\$23 275 California and \$23 800 Ontario).^{39–43} Both are places of concentrated poverty where people spend the majority of their incomes on life’s necessities. Although the health risks that poor Canadians are exposed to are similar to those of their American counterparts,^{42,44–46} Canadians have a distinct advantage. They enjoy access to a single-payer health care system.

We identified vulnerable places characterized by low supply of physicians. We joined participants to county-level active physician data via Canadian Institute for Health Information and American Medical Association databases (2000–2001).^{47–51} PCPs reported general or family practice. Physicians who reported the majority of their time in specialized practice or were board certified in that specialty were so defined.^{23,52} Threshold effects, below which participants were less likely to receive optimal care, were identified by exploring increments (0.25 physicians/10 000): < 7 PCPs or 13 specialist physicians (SPs) per 10 000 community inhabitants. Thresholds were not observed for specific SPs most involved in breast cancer care such as medical or surgical oncologists, general surgeons, obstetricians/gynecologists, pathologists, or radiologists. So SPs were analyzed in aggregate.

Analysis

Cohorts were 6300 in California and 950 in Ontario. Stage and treatment data had to be collected from health records across Ontario. We oversampled multiple “controls” in California allowing for detection of rate differences of 2% (2-tailed $\alpha = .05$; power_{1- β} = 0.80).⁵³ We created a guideline-based measure of optimal care (1 = optimal, 0 = suboptimal): diagnosed with node negative disease (before spread to regional lymph nodes) and received breast-conserving surgery followed by adjuvant radiation therapy.⁵⁴ The optimal care measure seemed valid as those not receiving it were three times as likely to die over 10 years in both countries.⁵⁵

We hypothesized that poverty better predicts suboptimal care in the United States, while PCP supply better predicts

optimal care in Canada. We explored SP effects. Hypotheses concerned interactions: poverty-by-country and PCP supply-by-country. We used logistic regression to test them.^{56,57} Age confounds any cancer study. Whether one lives in an urban or rural places also does. These were accounted for. The vast majority of node negative tumors were small, low grade, and hormone-receptor positive. Year of diagnosis may also confound analyses. After adjusting for age and place these factors did not affect findings so they were not included in regressions or adjustments. All variables had less than 3% missing data. Odds ratios (ORs) and confidence intervals (CI) were regression estimated. Survival analysis used a Cox regression.⁵⁵ We then described interactions, comparing within and between-country care rates across poverty and physician supply strata. Critical between-country comparisons were among study participants living in high poverty neighborhoods or in communities inadequately supplied with physicians. Other critical comparisons that involved potentially inadequately insured participants in California, compared with all of the necessarily insured participants in Ontario, were explored. We directly adjusted all rates by age and place, with our combined California-Ontario sample as the standard. Standardized rates were reported as percentages. Rate ratios (RRs) with 95% CIs were used for comparisons.^{58,59} Further details were published.⁶⁰⁻⁶²

Results

First, in terms of unadjusted prevalence estimates the women with breast cancer in the California and Ontario samples were nearly identical on age and tumor stage and grade at diagnosis. They were also quite similar on other tumor characteristics (Table 1). But crude treatment rates were all significantly greater in Ontario. Then, the logistic model of optimal breast cancer care showed that the main effects of poverty, PCP and SP supplies as well as their interactions with country were all significant (Table 2). The 2 hypothesized interactions were in the predicted direction. Greater risk was associated with poverty in the United States (OR = 0.59) and greater benefit with primary care in Canada (OR = 1.52). There was also evidence of a SP protective effect in the United States. There was no main effect of country and only 31% of the participants received optimal care.

Socioeconomically Vulnerable

Interactions are depicted in Table 3. The poverty-suboptimal care gradient was steep in California (RR = 0.69), but not significant in Ontario. Consequently, among women who lived in poverty, those in Ontario (38%) were much more likely to receive optimal care than those in California (23%; RR = 1.65). The Canadian advantage was greater when the uninsured or publicly-insured in California were the focus (18%; RR = 2.12, 95% CI 1.76-2.56). A modest Canadian

Table 1. Demographic and Clinical Characteristics of Women with Breast Cancer: Percentage Distributions in California and Ontario, 1996 to 2014.^a

	California (%)	Ontario (%)
Age (years)		
25-44	14.3	13.8
45-54	22.0	24.0
55-64	21.3	22.8
65-74	21.8	22.3
>75	20.5	17.1
At the time of diagnosis		
Node negative disease	66.2	65.8
Small tumor (<20 mm)	54.2	51.2
Low grade, well to moderately differentiated tumor*	62.4	66.9
Hormone-receptor positive*	78.4	82.4
Initial cancer-directed treatments		
Received surgery*	94.4	98.9
Breast-conserving surgery*	51.3	68.8
Received radiation therapy*	47.0	58.8

^a California and Ontario samples were equal represented by residents of high-, middle-, and low-poverty neighborhoods and by residents of large or small urban or rural places (one-third in each category) as the original sampling frame was so stratified.

* $P < .05$ for between-country difference (χ^2 test).

advantage even persisted when privately insured Californians were the focus (30%; RR = 1.27, 95% CI 1.06-1.52).

Underserved Communities

The PCP-optimal care gradient was steep in Ontario (RR = 1.43), but gentle in California (RR = 1.07). Consequently, in adequately supplied communities where PCP densities were 7 or more per 10000 inhabitants, women in Ontario (43%) were more likely to receive optimal care than their counterparts in California (31%; RR = 1.38). This relationship was not affected by health insurance. The SP-optimal care gradient was moderate in California (RR = 1.26), but nonexistent in Ontario. In inadequately supplied communities, Ontarians (34%) were more likely to receive optimal care than Californians (26%; RR = 1.33). Moreover, SP-underserved communities in Ontario (mean = 6.7, SD = 1.3) had nearly 2 more PCPs per 10000 inhabitants than similar communities in California (mean = 4.9, SD = 0.9), $P < .001$. Finally, when the effects of poverty, health insurance, supply of physicians and optimal care were accounted for, there was no main effect of country on survival.

Discussion

This is the first report of the effects of poverty, primary care, and health insurance on breast cancer care in Canada and the United States. Care was more accessible to women

Table 2. Logistic Regression Results: Effects of Country, Neighborhood Poverty, and Community Supply of Physicians on Optimal Breast Cancer Care in California and Ontario, 1996 to 2014.

Baseline Comparison		
Observed Group	Odds Ratio	95% Confidence Interval
<i>Main effects</i>		
California		
Ontario	1.02	0.82-1.28
Lower poverty neighborhoods		
High-poverty neighborhoods (30% or more poor)	0.59	0.52-0.67
Lower primary care physician (PCP) density communities		
High PCP communities (7 or more per 10000)	1.28	1.12-1.46
Lower specialist physician (SP) density communities		
High SP communities (13 or more per 10000)	1.45	1.25-1.69
<i>Significant interaction effects</i>		
<i>Main effects within country strata</i>		
Neighborhood poverty by country***		
High neighborhood poverty in the US	0.59	0.49-0.70
High neighborhood poverty in Canada	1.14	0.83-1.56
Community PCP density by country**		
High community PCP density in the US	0.98	0.84-1.15
High community PCP density in Canada	1.52	1.05-2.21
Community SP density by country*		
High community SP density in the US	1.32	1.16-1.50
High community SP density in Canada	1.14	0.80-1.63

^a The fit of the regression with the interaction effects was significantly better than the model without them: likelihood ratio test, $P < .001$. Significant odds ratios < 1.00 indicate risks and those > 1.00 indicate protections. Statistically significant odds ratios are bolded.

* P interaction = .065, ** P interaction $< .01$, *** P interaction $< .001$.

Table 3. Effects of Interactions of Neighborhood Poverty, Community Supply of Physicians and Country on Optimal Breast Cancer Care: California and Ontario, 1996 to 2014.

Baseline	California		Prevalence, %	Ontario		Canada/United States	
	Optimal Care Rate, %	Rate Ratio (95% CI)		Optimal Care Rate, %	Rate Ratio (95% CI)	Rate Ratio	95% CI
Observed Group	Prevalence, %						
Less than 30% vs 30% or more of households poor in neighborhood							
Lower poverty	66.7	33.6	66.7	34.8		1.04	0.91-1.19
High poverty	33.3	23.1	33.3	38.1	0.69 (0.63-0.75)	1.09 (0.92-1.30)	1.65 1.39-1.96
Less than 7 vs 7 or more primary care physicians (PCPs) per 10000 population in community							
Lower PCP density	53.7	29.2	59.8	29.9		1.02	0.90-1.17
High PCP density	46.3	31.2	40.2	42.9	1.07 (1.00-1.14)	1.43 (1.20-1.70)	1.38 1.20-1.58
Less than 13 vs 13 or more specialist physicians (SPs) per 10000 population in community							
Lower SP density	27.5	25.8	81.2	34.2		1.33	1.17-1.51
High SP density	72.5	32.4	18.8	36.0	1.26 (1.15-1.38)	1.05 (0.88-1.25)	1.11 0.93-1.33

^a Significant interactions that were found (Table 2) are here described with age and place standardized optimum care rates and rate ratios. Significant rate ratios < 1.00 indicate risks and those > 1.00 indicate protections. Statistically significant rate ratios are bolded.

in Ontario than in California. In addition to their advantage in communities adequately supplied with PCPs, Ontarian women were advantaged in the most vulnerable places: high-poverty neighborhoods and communities inadequately

supplied with specialists. Canadian advantages were fully explained by better access to primary care and health insurance. It is well known that Canadians had much better health insurance coverage during the pre-ACA era of this

historical cohort. All Canadians, for example, were covered for medically necessary breast cancer care, while millions of Americans were inadequately covered or not covered at all. This study discovered another distinct Canadian advantage however, especially among those who live in poverty or in communities that are otherwise not well endowed with specialized health care resources. PCP densities were much greater in such socioeconomically vulnerable places in Canada. These communities in Ontario have approximately 2 more PCPs for every 10 000 inhabitants than do similar communities in California. Canada's relatively greater primary care investment seems to deliver more potent protective dividends, especially among the most vulnerable of its citizens who live in its otherwise most underserved places.

Practical Significance

Uninsured and publicly insured American women living in poverty were at greatest risk of receiving suboptimal care. Even having private insurance did not eliminate their disadvantage. These findings are consistent with well-known inequities of American health care. Those covered by Medicare need to purchase "medigap" insurance. Private insurance plans are categorized "bronze" to "platinum," some plans offering much better coverage than others. As some states expanded Medicaid, many have not, creating another multitiered system. The ACA may not be able to overcome such structural problems. In fact, the majority of plans purchased through ACA exchanges are bronze with high deductibles. Similarly compromised coverages with high out-of-pocket expenses were predicted for Medicaid's expansion.⁶³⁻⁶⁶ It seems that many previously uninsured are becoming underinsured.

Better health insurance accounted for much, but not all of the explanation for better care in Canada.^{9,16} Adding PCP supply this study fully accounted for it. We found evidence of more effective primary care in Canada. Moreover, Canada's primary care protections were greatest among the most vulnerable in the most underserved places. These findings suggest that the United States ought to retain recent ACA reforms and strengthen its primary care system. If further, single-payer, reform is not feasible, strengthening primary care will probably be the best way to maximize ACA benefits.⁶⁷ More than half of the people we studied, however, lived in communities with PCP shortages. To optimize breast cancer care, for example, we estimate that another 1700 PCPs are needed to bring all communities in California to the criterion of having an adequate primary care workforce of at least 7 PCPs for every 10 000 residents.

Applying our findings to population parameters we estimate that over a generation more than 200 000 American women were cared for less optimally than if they had universal access to primary care-oriented health care.^{2,3,68-70} This injustice is probably only the tip of the public health

iceberg as breast cancer accounts for a small fraction of the burden of disease in the United States.⁷¹ Replications of other outcomes are needed to examine ACA impacts and to plan physician needs.

Limitations

Our findings may not be generalizable across all of Canada and the United States. But given that 1 in 3 Canadians lives in Ontario and 1 in 10 Americans in California, we think they have substantial external validity.^{72,73} Admittedly, as we oversampled those living in poverty this study's findings are most representative of them. California recently expanded Medicaid more liberally than most other states so estimates of inequities there are very likely to be underestimates of the nation's.⁷⁴⁻⁷⁶ Retrospective studies can be methodologically limited; however, we still think it important to learn as much as we can from history.

Our poverty measure may be ecologically fallacious. It could be the ethnic composition of high-poverty neighborhoods, rather than their low incomes that matters. We think this unlikely for several reasons. First, although we were not able to account for this directly because the Ontario cancer registry does not record ethnicity, we were able to conservatively replicate our findings by comparing non-Hispanic white women in California with the entire ethnically diverse Ontario sample. We replicated the significant poverty-suboptimal care gradient in California as well as the Ontario advantage among women living in poverty. Second, studies have observed that ethnicity does not confound poverty.⁹⁻¹¹ Third, the poverty measures was similar in California and Ontario, typically differing by only \$525. Fourth, the ecological measure has been associated predictably with health insurance. Those living in poverty are twice as likely to be uninsured and 12 times as likely to be underinsured in California.^{16,77}

Conclusions

This study's observations of the protective effects of Canadian health care suggested ways to maximize ACA protections. Policy makers ought to ensure that the newly insured are adequately insured. No one should have to bear exorbitant out-of-pocket costs for medically necessary care. Medicaid should be equitably expanded across all states. In concert with insurance expansion, policies that expand the supply of PCPs promise the eradication of remaining barriers to high-quality health care for all.

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