

# Physician Supply and Breast Cancer Survival

Kevin M. Gorey, PhD, MSW, Isaac N. Luginaah, PhD, Karen Y. Fung, PhD, Emma Bartfay, PhD, Caroline Hamm, MD, Frances C. Wright, MD, MEd, Madhan Balagurusamy, MSc, and Eric J. Holowaty, MD

**Background:** This study tested the hypothesis that physician supply thresholds are associated with breast cancer survival in Ontario.

**Methods:** The 5-year survival of 17,820 female breast cancer patients diagnosed between 1995 and 1997 was surveilled until 2003 for all-cause mortality. Physician supply densities in 1991 and 2001 were computed for 49 Ontario regions.

**Results:** There were independent threshold effects for general practitioners (GP; 7.25 per 10,000) and obstetrician/gynecologists (OB/GYN; 6 per 100,000) at or above which women with breast cancer were more likely to survive for 5 years. The respective risk of living in areas undersupplied with OB/GYN and GP increased 30% to nearly 5-fold during the 1990s. Five-year survival tended to be lower in provincial areas outside of Toronto, which experienced GP (odds ratio, 0.83; 90% CI, 0.70–0.99) and OB/GYN (odds ratio, 0.76; 95% CI, 0.61–0.96) supply decreases.

**Conclusion:** As they do in America, primary care physician supplies in Canada seem to matter in the effective provision of cancer care. Community resources such as health care service endowments, including physician supplies, may be particularly critical to the performance of health care systems such as Canada's, which aim to provide medically necessary care for all. (J Am Board Fam Med 2010;23:104–108.)

Supplies of primary care physicians have been consistently and significantly associated with improved

health outcomes (eg, all-cause, cancer, heart disease, stroke, and infant mortality) among the past generation in the United States.<sup>1</sup> Some US studies have focused on a sentinel health indicator of great public health significance—breast cancer—and found that supplies of community primary care physicians, typically at the county level, were significantly associated with more localized disease at diagnosis and longer breast cancer survival.<sup>2,3</sup> These advantages seemed to be fairly specific to primary care, with overall supplies of physicians generally not being predictive. Beyond our own research, which demonstrated significant primary care physician density–cancer care associations,<sup>4</sup> we are not aware of any such Canadian physician supply–cancer care knowledge. It certainly seems plausible that, in a single-payer, universally accessible health care system such as Canada's, community or regional health care service endowments, a key element of which is primary care physician supply,<sup>5,6</sup> would be critical.

A recent retrospective cohort study found that little of the geographic or temporal variability in survival among women with breast cancer in Ontario can be accounted for by personal resources, such as annual household incomes.<sup>7</sup> It maximized generalizability as it studied population cohorts,

This article was externally peer reviewed.

Submitted 30 March 2009; revised 7 July 2009; accepted 13 July 2009.

From the School of Social Work (KMG) and the Department of Mathematics and Statistics (KYF, MB), University of Windsor, Windsor; Department of Geography, University of Western Ontario, London (INL); Faculty of Health Sciences, University of Ontario Institute of Technology, Oshawa (EB); Clinical Trials and Research, Windsor Regional Cancer Center, Windsor (CH); Department of Surgery, University of Toronto, and Sunnybrook Health Sciences Centre, Toronto (FCW); and Division of Preventive Oncology, Cancer Care Ontario, Toronto (EJH), Canada.

**Funding:** This research was supported in part with funds from the Canadian Breast Cancer Research Alliance (Canadian Institutes of Health Research grant no. 67161); the Canadian Cancer Society (National Cancer Institute of Canada grant no. 016160); the Social Sciences and Humanities Research Council of Canada (grant no. 410-2002-0173); as well as a Canadian Institutes of Health Research investigator award and partnership appointment to its first and second investigators (KMG and INL).

**Conflict of interest:** none declared.

**Corresponding author:** Kevin M. Gorey, PhD, MSW, Professor and Assumption University Research Chair in Canadian and American Population Health, School of Social Work, University of Windsor, 401 Sunset Avenue, Windsor, Ontario, N9B 3P4, Canada (E-mail: gorey@uwindsor.ca).

See Related Commentary on Page 6.

but its breast cancer cases were not staged. A contemporaneous Ontario study found significant threshold effects for primary care physician densities, above which women with breast cancer were more likely to be diagnosed with localized disease and to live longer.<sup>4</sup> It studied staged breast cancer but used smaller purposive samples from a large metropolitan area (Toronto), a mid-sized city (Windsor), and rural locations that were not necessarily representative of the province as a whole. Based on these and related research findings,<sup>8,9</sup> we theorize that key community-level resources, such as physician supplies, may be as predictive in Canadian contexts as personal resources are in American contexts. Joining the 2 noted studies' databases—large provincial breast cancer and physician supply cohorts—provided an opportunity to test a more generalizable primary care physician supply–breast cancer survival hypothesis.

## Methods

This study was reviewed and cleared by the University of Windsor's research ethics committee and the Ontario Cancer Research Network's research ethics board. All 17,829 women 25 years of age or older and diagnosed with primary invasive breast cancers in Ontario between January 1, 1995, and December 31, 1997, were followed until 2003 (International Classification of Diseases 9 code 174). These cases were identified by the Ontario Cancer Registry, a comprehensive cancer surveillance system of demonstrated validity.<sup>10</sup> Based on the Scott's Medical Database, records of all 19,204 and 20,828 physicians active in Ontario during the years 1991 and 2001, respectively, were obtained from the Canadian Institute for Health Information (CIHI) and joined to the breast cancer data by census divisions. There are 49 such regions in the province that correspond to counties, districts, or regional municipalities. A series of interagency validity checks (CIHI and Scott's Directories) and CIHI edit checks ensured that error rates were almost nonexistent for all variables (only 0.2% for primary care physicians and specialists).<sup>11</sup> Each physicians' preferred business mailing address served as a proxy for their practice location. Primary care physicians or general practitioners (physicians in Canada without certification for a current medical specialty) included family medicine and emergency family medicine physicians. Emergency

medicine certification of family medicine physicians was instituted in Canada more than a generation ago, with family medicine physicians commonly taking shifts in local emergency rooms and providing much of the emergency care in suburban and rural areas.<sup>12,13</sup> Because they often provide primary care for women, the independent effects of those whose current medical specialty was obstetrics and gynecology (OB/GYN) were explored.

Previously identified primary care thresholds were tested: 7 or more general practitioners (GPs) per 10,000 population, and 6 or more OB/GYN per 100,000.<sup>4</sup> That Ontario study observed, for example, that regions with GP densities of 7 or more per 10,000 residents enjoyed significantly better breast cancer survival than did those with lower GP densities. However, further GP density increments to 8, 9, or even 10 or more GPs per 10,000 residents did not seem to be associated with any further gains in breast cancer survival. The effects of physician supplies in 2001 as well as changes during the 1990s (1991 to 2001) were tested. Place differences were also explored. Maximum likelihood logistic regression models were used to estimate the associations of physician supplies with 5-year all-cause survival. Age-, income-, and distance (to regional cancer centers)-adjusted odds ratios (OR) and 95% CIs were estimated from regression statistics.<sup>14</sup> Cases were joined to a census tract-based measure of socioeconomic status (prevalence of "low-income" households [census subdivision based in rural areas]) to account in part for personal economic status.<sup>15–18</sup> Ninety percent CIs were reported when findings approached statistical significance.

## Results

Provincial threshold effects that were observed for GPs are displayed in Table 1. The previously identified threshold criterion of  $\geq 7$  GPs per 10,000 population approached statistical significance (OR, 1.09; 90% CI, 1.00–1.19). Sensitivity explorations, however, systematically replicated the significant GP density–breast cancer survival association with a slightly higher threshold of 7.25 GPs per 10,000 population (OR, 1.14; 95% CI, 1.01–1.29). The odds of surviving for 5 years for breast cancer patients residing in areas with  $\geq 7.25$  GPs per 10,000 inhabitants were 14% greater than such odds among their counterparts in areas with  $< 7.25$

**Table 1. Associations of General Practitioner Supplies with Breast Cancer 5-Year Survival among Women in Ontario Diagnosed Between 1995 and 1997 and Followed Until January 1, 2003**

General Practitioner Supply Predictor	Risk Factor	Prevalence (%)	Breast Cancer 5-Year Survival (odds ratio [95% CI])
Provincial analysis of 17,829 breast cancer cases			
≥7 per 10,000 in 2001	<7	66.2	1.09 (0.98, 1.21)*
≥7.25 per 10,000 in 2001	<7.25	68.1	1.14 (1.01, 1.29)
Analysis of 10,745 cases outside the greater metropolitan Toronto area			
Decreased by ≥3 per 10,000 in 1991 and 2001 <sup>†</sup>		16.5 <sup>‡</sup>	0.83 (0.68, 1.03) <sup>§</sup>

All effects were adjusted for patient age, census tract low-income prevalence, census division age distribution, distance from regional cancer centers, and obstetrician/gynecologist supplies. Total physician density did not enter the model. There were 10,291 and 10,122 active general practitioners in Ontario in 1991 and 2001, respectively.

\*90% confidence interval did not include the null (1.00–1.19;  $P < .10$ ).

<sup>†</sup>Sensitivity analyses revealed the most predictive criterion decrement.

<sup>‡</sup>Overrepresented by small to mid-sized cities with populations between 100,000 and 500,000.

<sup>§</sup>90% CI did not include the null (0.70–0.99;  $P < .10$ ).

GPs per 10,000 inhabitants. The risk of living in such undersupplied areas increased nearly 5-fold during the 1990s. The 2001/1991 (68.1% vs 14.2%, respectively) GP age-adjusted rate ratio was 4.80 (95% CI, 4.72–4.88). Women with breast cancer who lived in regions outside of the greater metropolitan Toronto (GMT) area, where GP supplies had substantially decreased during the 1990s, tended to be less likely to survive for 5 years (OR, 0.83; 90% CI, 0.70–0.99) than their counterparts in regions that experienced fewer such losses. This association was not observed in the GMT area.

Threshold effects observed for OB/GYNs are displayed in Table 2. The previously identified threshold criterion of ≥6 OB/GYNs per 100,000 population was replicated (OR, 1.13; 95% CI,

1.01–1.27). The odds of surviving for 5 years for breast cancer patients residing in areas with ≥6 OB/GYNs per 100,000 inhabitants were 13% greater than those among their counterparts in areas with <6 OB/GYNs per 100,000 inhabitants. Again, the risk of living in such undersupplied areas increased substantially during the 1990s; 2001/1991 (59.7% vs 45.9%, respectively) OB/GYN age-adjusted rate ratio was 1.30 (95% CI, 1.27–1.33). Women with breast cancer who lived in regions outside of the GMT area, where OB/GYN supplies had decreased substantially during the 1990s, tended to be less likely to survive for 5 years (OR, 0.76; 95% CI, 0.61–0.96) than their counterparts who lived in regions that experienced fewer such losses. Again, this association was not ob-

**Table 2. Associations of Obstetrics/Gynecology Specialist Supplies with Breast Cancer 5-Year Survival in Ontario: Women Diagnosed Between 1995 and 1997 Were Followed Until January 1, 2003**

Obstetrician/Gynecologist Supply Predictor	Risk Factor	Prevalence (%)	Breast Cancer 5-Year Survival (OR [95% CI])
Provincial analysis of 17,829 breast cancer cases			
≥6 per 100,000 in 2001	<6	59.7	1.13 (1.01–1.27)
Analysis of 10,745 cases outside the greater metropolitan Toronto area			
Decreased by ≥2 per 100,000 in 1991 and 2001*		20.2 <sup>†</sup>	0.76 (0.61–0.96)

All effects were adjusted for patient age, census tract low-income prevalence, census division age distribution, distance from regional cancer centers, and general practitioner supplies. Total physician density did not enter the model. There were 648 and 664 active obstetrician/gynecologists in Ontario in 1991 and 2001, respectively.

\*Sensitivity analyses revealed the most predictive criterion decrement.

<sup>†</sup>Overrepresented by small to mid-sized cities with populations between 100,000 and 500,000.

served in the GMT area. No other aspect of place (large urban to extremely remote rural areas) entered any of the regression models.

## Discussion

This large, representative, retrospective cohort study tested primary care physician supply–breast cancer survival threshold effects in Ontario. Physician undersupply thresholds were significantly associated with lower survival among patients. Although effects were apparently modest (both GP and OB/GYN supply-survival ORs were approximately 1.15), the risk of living in undersupplied communities increased by 30% (OB/GYNs) to nearly 400% (GPs) during the 1990s. It seems that the population-level effects of supplies of primary care physicians may be quite large. Such clearly identified physician supply–health threshold effects provide empirical reasons to be hopeful that areas identified as being undersupplied by physicians can be rectified through rational, cost-effective planning. Certain vulnerable communities of relatively extreme undersupply because of losses during the 1990s, overrepresented by small to mid-sized cities, probably ought to be the first targets of such policy planning. There would also seem to be clear policy planning benefits in the future study of primary care and diverse specialist physician care across other prevalent health problems and health care domains.

This study is consistent with US studies that have observed significant benefits of adequate supplies of primary care physicians in cancer care and other health care domains.<sup>1</sup> Its findings are also consistent with the developing theory that such community-level resources, proxies for regional health care service endowments, are probably more predictive in Canadian contexts than are personal resources.<sup>4–7</sup> However, it should be noted that this study's physician counts were only “head-counts” of active physicians. This conceivably could have been problematic because it did not allow for the estimation of physician full-time equivalents, a measure of physician workload. Head-count data has been demonstrated to result in physician/population ratios that are overestimates of physician full-time equivalents; however, such overestimation has also been suggested to be least problematic more in Ontario

than in any other Canadian province (5% to 10%).<sup>19</sup> Any such slight overestimation could be easily accounted for in planning future supplies of physicians.

## Conclusion

Regional supplies of primary care physicians seem to matter in the effective provision of cancer care in Canada. Community health care service endowments that include adequate physician supplies may be particularly critical to the performance of a health care system, such as Canada's, that provides universal accessibility to medically necessary care.

---

The authors gratefully acknowledge the technical assistance of John David Stanway, Senior Analyst, Canadian Institute for Health Information. We also gratefully acknowledge the research and technical assistance of Carole Herbert (Cancer Care Ontario), Leah Archambault, Natalie Herbert, Dylan Herbert, and Nancy Richter (University of Windsor).

## References

1. Macinko J, Starfield B, Shi L. Is primary care effective? Quantifying the health benefits of primary care physician supply in the United States. *Int J Health Serv* 2007;37:111–26.
2. Ferrante JM, Gonzalez EC, Pal N, Roetzheim RG. Effects of physician supply on early detection of breast cancer. *J Am Board Fam Pract* 2000;13:408–14.
3. Fleisher JM, Lou JQ, Farrell M. Relationship between physician supply and breast cancer survival: a geographic approach. *J Community Health* 2008;33:179–82.
4. Gorey KM, Luginaah IN, Holowaty EJ, Fung KY, Hamm C. Associations of physician supplies with breast cancer stage at diagnosis and survival in Ontario, 1988 to 2006. *Cancer* 2009;115:3563–70.
5. Sarma S, Peddigrew C. The relationship between family physician density and health related outcomes: the Canadian evidence. *Cah Sociol Demogr Med* 2008;48:61–105.
6. Baicker K, Chandra A. Medicare spending, the physician workforce, and beneficiaries' quality of care. *Health Aff (Millwood)* 2004;(Supplemental Web Exclusives):W184–97.
7. Gorey KM, Fung KY, Luginaah IN, et al. Cancer survival in Ontario, 1986–2003: evidence of equitable advances across most diverse urban and rural places. *Can J Public Health* 2008;99:12–6.
8. Gorey KM, Holowaty EJ, Fehringer G, Laukkanen E, Richter NL, Meyer CM. An international comparison of cancer survival: metropolitan Toronto, Ontario, and Honolulu, Hawaii. *Am J Public Health* 2000;90:1866–72.

9. Gorey KM, Holowaty EJ, Fehringer G, et al. An international comparison of cancer survival: Toronto, Ontario, and Detroit, Michigan, metropolitan areas. *Am J Public Health* 1997;87:1156–63.
10. Hall S, Schulze K, Groome P, Mackillop W, Holowaty E. Using cancer registry data for survival studies: the example of the Ontario Cancer Registry. *J Clin Epidemiol* 2006;59:67–76.
11. Canadian Institute for Health Information. Supply, distribution and migration of Canadian physicians, 2006. Ottawa: Canadian Institute for Health Information; 2007.
12. Chan BTB. Do family physicians with emergency medicine certification actually practice family medicine? *CMAJ* 2002;167:869–70.
13. Ovens H, Allen R, Cohen E. Who will practice emergency medicine? Survey of family medicine graduates. *Can Fam Physician* 1993;39:1356–65.
14. Hosmer DW, Lemeshow S. *Applied logistic regression*, 2nd ed. New York: John Wiley & Sons; 2000.
15. Statistics Canada. Profiles of census divisions and subdivisions, 2001 (Ontario). Ottawa, 2002.
16. Statistics Canada. Profiles of census divisions and subdivisions, 1991 (Ontario). Ottawa, 1992.
17. Statistics Canada. Profiles of census tracts, 2001 (Ontario). Ottawa, 2002.
18. Statistics Canada. Profiles of census tracts, 1991 (Ontario). Ottawa, 1992.
19. Pong RW, Pitblado JR. Geographic distribution of physicians in Canada: beyond how many and where. Ottawa: Canadian Institute for Health Information; 2005.