Financial Implications of the Continuity of Primary Care

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ABSTRACT

Background: The objective of this study was to assess the financial implications of the continuity of care, for patients with high care needs, by examining the cost of government-funded health care services in British Columbia, Canada.

Methods: Using British Columbia Ministry of Health administrative databases for fiscal year 2010-2011 and generalized linear models, we estimated cost ratios for 10 cost-related predictor variables, including patients' attachment to the practice. Patients were selected and divided into groups on the basis of their Resource Utilization Band (RUB) and placement in provincial registries for 8 chronic conditions (1,619,941 patients). The final dataset included all high- and very-high-care-needs patients in British Columbia (ie, RUB categories 4 and 5) in 1 or more of the 8 registries who met the screening criteria (222,779 patients).

Results: Of the 10 predictors, across 8 medical conditions and both RUBs, patients' attachment to the practice had the strongest relationship to costs (correlations = -0.168 to -0.322). Higher attachment was associated with lower costs. Extrapolation of the findings indicated that an increase of 5% in the overall attachment level, for the selected high-care-needs patients, could have resulted in an estimated cost avoidance of $142 million Canadian for fiscal year 2010-2011.

Conclusions: Continuity of care, defined as a patient's attachment to his/her primary care practice, can reduce health care costs over time and across chronic conditions. Health care policy makers may wish to consider creating opportunities for primary care physicians to increase the attachment that their high-care-needs patients have to their practices.

INTRODUCTION

The objective of this study was to assess the financial implications of continuity of care, for high-care-needs patients, by examining the cost of government-funded health care services in British Columbia (BC), Canada.

Continuity of Care

There is a consensus that continuity of care can improve the quality of patient care[1-3] and a concomitant belief that continuity of care and care coordination can be cost-effective.[4] Starfield and colleagues[5] have pointed out that a discontinuity of primary care leads to patients seeking more specialist care, thereby increasing overall costs. However, empirical studies on the potential cost avoidance directly related to the continuity of primary care are few.

The cost-effectiveness of continuity of care has typically been inferred from its impacts on cost-related variables (eg, number of hospital admissions) but not directly on costs. For example, continuity of care has been associated with decreased hospital visits in the US[6] and reduced ambulatory care-related hospitalizations in Canada.[7] Conversely, lacking a primary care physician has been associated with an increased rate of hospital admissions,[8] and in Ontario, Canada, patients without a regular family physician were 1.22 times more likely to visit an Emergency Department and 1.32 times more likely to have had a medical, nonelective hospital admission than were patients who reported having a regular family physician or general practitioner (GP).[9]

In the conceptual framework of continuity of care described by Haggerty et al,[1] three types of continuity of care were identified. Management continuity relates to the delivery of services by different care providers in a timely and complementary manner such that care is connected and coherent. Informational continuity refers to the extent to which information about past care is used to make current care appropriate to the patient. Finally, relational continuity refers to the therapeutic relationship between a patient and one or more providers that spans various health care events and results in an accumulated knowledge of the patient and care consistent with the individual's needs. In our study, we used the concept of relational continuity between the patient and the primary care practice where the individual obtained most of his/her care, and operationalized it as the patient's attachment to the main practice (see the section Attachment to Practice and Costs for a full definition).

Primary Care in British Columbia

British Columbia has funded, and continues to fund, family physicians primarily on a fee-for-service basis. GPs bill the BC Medical Services Plan, which is funded by the government. Reimbursement is rapid (most often within one month to six weeks), but is subject to a retrospective audit. There are also some sessional payments (usually blended with fee-for-service) provided for specific populations. BC has not adopted capitation payments for GPs except for a few small experiments. Salaried positions have not been offered for full-service GPs for many years. Conceptually, the BC model of primary care is very similar to the US concept of the patient-centered medical home.[10]

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Canada's most westerly province, BC has a population of approximately 4.4 million inhabitants. It is a multicultural province with representation from a variety of racial and ethnic groups. Approximately 50% of the population lives in the Vancouver and lower mainland areas. A large part of the province could be described as small town and rural and, in the north, even remote. This is true for many Canadian provinces. Canada's population is about one-tenth that of the US, and BC's population is approximately 13% of that of Canada. The median annual household income in BC in 2006 was Can$46,472 (Canadian dollars), and the average age of its citizens in 2011 was 41.9 years.[10]

Regarding GP income, the British Columbia Medical Association (now renamed Doctors of BC) indicates that in the 2011-2012 fiscal year (April 1, 2011, to March 31, 2012), the average income for all GPs was Can$199,512. To estimate income for regularly practicing GPs, Doctors of BC also uses a second estimate that excludes part-time GPs. For the 2011-2012 fiscal year, this cutoff point was Can$82,500. Thus, for GPs with incomes greater than Can$82,500, the average annual income, based on claims made to the BC Medical Service Plan, was Can$255,522. In accordance with the Canadian Constitution, the provision of health services is a provincial responsibility. Provincial and federal taxes are collected by the federal government, which provides health funding to the provinces through the Canada Health Transfer. Physician services and hospital services are single-payer, insured services, and, thus, residents of BC generally receive medical and hospital services without a charge or user fee. No other services are insured services and, thus, there is a complex set of rules regarding copayments for drugs, long-term care, and other allied health services.[10]

Primary care in BC is mainly provided by solo practitioners or small group practices. For payment and statistical purposes, individual physicians are identified by a practitioner number, and practices (corporations, sole proprietorships, etc) of one or more physicians are identified by a payee number (payments are made to the payee). Thus, for example, a GP operating as a solo practitioner would have 1 practitioner number and 1 payee number. In the 2010-2011 fiscal year there were 3397 practices (as defined by the payee number). Of this number, 1692 practices were composed of a single full-time or part-time GP. Only 524 (15.4%) of practices had more than 4 GPs.

Medical Services Plan payments are made on the basis of services provided in an extensive fee schedule. Generally, one service is provided during one visit. However, if the GP provides two unrelated services during one visit, the GP can bill for two services for that visit. Given how medical care is provided in BC, GPs, even in solo or small practices, can generally care for a range of patients, including those needing complex care. Incentive payments recently added to the fee schedule allow GPs to develop care plans and to take more time with their patients who have chronic or complex conditions.[10]

The BC Ministry of Health has developed a series of registries containing the records of people with chronic conditions. Patients in a given registry, such as diabetes, may have diabetes alone or may have diabetes plus other chronic conditions. In this article, we present findings based on data from eight different registries of chronic conditions. Thus, we have effectively conducted eight replications of our main finding, for patients with different chronic conditions.

Attachment to Practice and Costs

Hollander et al[11] reported a clear inverse relationship between a patient's attachment to a primary care practice and overall health care costs for hospital care, medical care, and the use of drugs. Those analyses were conducted for patients in BC with diabetes and congestive heart failure (CHF) at Resource Utilization Bands (RUB) categories 4 and 5 (hereafter referred to as RUB 4 and RUB 5, ie, high and very high-care-needs patients) using data for the 2007-2008 fiscal year. The RUBs are as defined in The Johns Hopkins Adjusted Clinical Groups Case-Mix System (described at www.healthpartners.com/files/57460.pdf). The patient's attachment to practice (defined as the percentage of services provided by the practice that provided the most services) was by far the strongest predictor of costs, and the relationship held after controlling for 9 other cost-related variables (eg, patient's age, sex, geographic location). For these groups of patients, the stronger the patient's attachment to practice, the lower the patient's health care costs.

The inverse relationship between attachment and costs was found to be quite robust. In a number of additional analyses (not presented here, but available on request), we found that the inverse relationship between attachment and cost held up in the context of each of the other predictor variables we used in our analyses (eg, patient age, income, physician sex, physician place of graduation; see the Methods section). For example, when we looked at the relationship in the context of the patients' age, we stratified the population into several age categories (eg, younger than 44 years, 45-64 years, 65-74 years, and 75 years and older) and found that even though the actual dollar amounts differed (eg, older patients had overall higher costs than younger patients), the inverse relationship between attachment and costs, which is the main focus of this article, held consistently. Similarly, we also found that the relationship held regardless of the number of chronic conditions the patient had.

The logic for focusing on attachment to a practice, rather than an individual GP, is as follows. If a patient has 12 services in a year and 9 of those services are from 1 practice, the patient's attachment level would be 75% (9 of 12 services provided by the main practice). However, if the main GP in the practice provides 6 services and the other 3 services are provided by locum tenens or colleagues in the group practice whose billings go through the same payee number (ie, the payee number for that practice) the attachment level would be 50% (6 of 12 services). Given that the other services are provided on behalf of the main GP and not by other separate practices (drop-in clinics or GPs working in Emergency Departments), it was deemed that the most appropriate

indicator of continuity of care would be attachment to the practice of the main GP.

We postulate that continuity of care is inversely related to costs because of the regular and continuous relationship that develops between the GP and the patient. Through such a relationship, the GP is able to have a better understanding of the patient's health issues and life circumstances. Conversely, the patient trusts the GP and may reveal matters that may be of some tentative concern to him/her. This provides the GP and the patient the opportunity to anticipate and prevent or mitigate future health problems, which, in turn, can lead to a reduction in overall hospital days per year. This two-way interaction also means that GPs may not have to see patients as frequently compared with cases in which patients do not have a regular GP and instead go to drop-in clinics or Emergency Departments when they have a health concern. Thus, although the main cost reductions for patients with a high level of attachment are the result of their lowered use of hospital beds, these patients also use fewer GP services than do patients with low levels of attachment.[11]

In this study, we examined how attachment to practice, as a measure of continuity of care, directly affects total annual health care costs per patient for high-care-needs patients who have several different chronic conditions. Our goals were to replicate the findings of the study by Hollander et al[11] for patients with diabetes and CHF with data from the 2010-2011 fiscal year, and expand the findings to patient groups with other chronic conditions.

METHODS

Setting

Data were extracted from the BC Ministry of Health's administrative databases for the 2010-2011 fiscal year. Access to the administrative data was obtained under a Ministry of Health Privacy Impact Assessment, which protects BC residents from unauthorized and/or inappropriate use of their private medical information and confirms that the analyses conducted will be done ethically and with respect for patient privacy.

Patients

The Ministry's databases contain data for all BC residents with a Medical Services Plan number, and for physicians and their billing practices. Because this study is in part a replication of the previous study,[11] we used the same criteria to screen out patients who were atypical on the key predictor variables. Specifically, the inclusion criteria were:

- Adults age 18 years or older
- A minimum of 5 GP services
- RUB category 4 or 5 (the patient's overall health level likely affected their service usage and the costs of health care)
- Estimated not to have lived in a long-term-care facility in the 2010-2011 fiscal year
- Had not died in the 2010-2011 fiscal year
- Hospital costs that did not exceed Can$100,000. The rationale for this criterion was that hospital costs of more than Can$100,000 would indicate a patient who spent considerable time in hospital (eg, if the average hospital cost is Can$1000 per day, an annual cost of Can$100,000 implies a hospital stay of 100 days), but our study was about general practice and GPs caring for people living in the community. The number of patients excluded ranged from 7 to 29 per registry at RUB 4—or in percentages, fewer than 0.01% (diabetes) to 0.10% (stroke) of patients. There were 225 to 543 patients excluded at RUB 5, or between 0.76% (hypertension) and 2.25% (chronic kidney disease) of patients.
- Visits to 25 or fewer payees. This criterion was used in our previous study, but no patients were eliminated on the basis of this criterion in the present dataset.

These criteria and rationale are discussed more fully in the article by Hollander et al.[11] We did, however, examine the distributions of all variables used in these analyses to ensure that the cutoff points for the inclusion criteria continued to be reasonable. As a result, we eliminated 22 patients whose costs through BC PharmaCare (a Ministry of Health assistance program for eligible prescription drugs and medical supplies) were atypical from the population as a whole (ie, greater than Can$100,000) because they skewed the data. No further adjustments of the various cutoff points were required. Only patients who met all of our inclusion criteria were retained for analysis. It should be noted that our dataset is not a sample; rather it contains the total population of British Columbians who met our selection criteria.

Patients in the following eight registries were analyzed: diabetes, CHF, chronic obstructive pulmonary disease (COPD), hypertension, angina, chronic kidney disease, osteoarthritis, and stroke.

Design and Statistical Analyses

The basic research question was to examine how a number of patient and practitioner variables influence health care costs. In this replication, we used 10 cost-related predictors. Five predictor variables related to patient characteristics: age, sex, residence location (4 categories of a "rurality index" defined for communities in BC[12]), median after-tax household income, and attachment to practice (the percentage of billable primary care services billed by the practice that billed for most of the patient's services in 1 year). Five predictor variables related to the patient's main GP's characteristics: sex, length of time in family practice, full-time equivalent (FTE) status, number of physician payee numbers that the practitioner had (as a measure of the number of locations at which the physician practices), and whether the physician had graduated from medical school in Canada. The physician data were based on the physician in the practice who provided the most services to the patient. Separate analyses were conducted for patient groups defined by medical condition and RUBs 4 and 5.

The primary statistical analysis employed estimation of the generalized linear model with γ-distributed errors and the log link function, as recommended by Dunn et al[13] for modeling mental health care costs. This model choice fits our data and purpose well. The γ-distribution is appropriate for dependent variables, such as costs, that are positive, continuous, and positively

skewed, and using the log link function produces incidence rate ratios as the model coefficients, which are easy to interpret and compare across predictors. Statistical analyses were conducted using Stata Version 11 (StataCorp, College Station, TX). Robust variance estimation was used for statistical hypothesis testing, and we report 95% confidence intervals for all generalized linear model estimates. We also report the bivariate associations of each predictor with the total cost, as a first-step assessment of the relationship that each predictor has with, and contributes to, the primary outcome variable.

Primary Outcome Variable

The primary outcome variable was the total, annual, per-patient, government-related health care cost for services provided. This included: costs of GP, diagnostic (laboratory tests, imaging, etc), and specialist services covered by the BC Medical Services Plan; pharmacy costs; and inpatient hospital costs.

RESULTS

Table 1 provides descriptions for patients in the replication study: diabetes and CHF at RUBs 4 and 5. The groups of patients for the other 6 conditions we studied (ie, angina, chronic kidney disease, COPD, hypertension, osteoarthritis, and stroke) were generally similar to patients with diabetes and CHF shown in Table 1. Details about these groups are provided in Table 2, available online at: www.thepermanentejournal.org/files/Winter2015/ChronicConditions.pdf.

The bivariate correlation coefficients between total cost and each predictor variable are shown in Table 3, in the columns for fiscal year 2010-2011. Of the 10 predictors examined, attachment to practice had the strongest relationship with the total cost in each patient group, ranging from -0.190 (diabetes RUB 4) to -0.322 (CHF RUB 5). In all 4 groups, increased attachment to practice was associated with a decreased total cost of health care. As we report below, this relationship was maintained when the effects of all other cost-related predictors were taken into account. Compared with the results from our earlier study[11] shown in the columns headed 2007-2008 in Table 3, the correlations between attachment and total cost increased slightly over time, albeit not statistically significantly (except for diabetes RUB 5). Regarding the other patient predictors, the most consistent findings were that attachment and patient's household income remained or became more strongly correlated with total cost, such that patients with higher attachment levels and higher household incomes were associated with lower costs.

The pattern of relationships of the physician predictors with cost appears to be more consistent over time. Physician sex continued to have small to no impact on the cost across the four groups of patients. Physician place of graduation was a significant predictor of cost in three of the four groups, but no change was observed over the three-year period. Physician FTE factor, number of payee numbers, and to some degree years in practice showed stronger inverse relationships with cost in the more recent dataset.

The bivariate correlation coefficients between the predictors and costs for the remaining 6 chronic conditions studied are presented in Table 4. As was the case with diabetes and CHF, the patient's attachment to practice had by far the strongest association with total cost, and this was consistent across all chronic conditions at both RUBs. The patient's residence area, but not the patient's sex, was associated with total costs at RUB 5 in most chronic conditions. As expected, patient age was related to cost in most groups, with higher costs associated with older patients with COPD, hypertension (RUB 4 only), angina, and osteoarthritis. However, this pattern reversed such that lower costs were associated with older patients in RUB 5 who had hypertension, chronic kidney disease, and stroke. The reasons for the latter finding are unclear in this context, but further explorations confirmed our main finding—the inverse

Table 1. Description of patients in the 2010-2011 study[1]

	Diabetes		Congestive heart failure	
Demographic and cost variables	RUB 4 (n = 47,783)	RUB 5 (n = 26,588)	RUB 4 (n = 20,112)	RUB 5 (n = 17,196)
Demographic and predictor variables for patients:				
Age, years,[a] mean (SD)	66.8 (14.2)	70.0 (12.7)	75.4 (12.4)	76.5 (11.7)
Male sex, %	51.5	57.1	53.2	55.6
Type of community,[b] %				
Metropolitan	41.2	39.3	36.5	36.6
Urban	42.6	43.5	44.3	44.2
Town	11.0	12.0	12.8	13.2
Village	5.2	5.2	6.4	5.9
Median family income, Can$, mean (SD)	47,688 (9091)	47,315 (9184)	47,387 (9105)	47,279 (9231)
Attachment to practice, %, mean (SD)	79.7 (19.2)	72.5 (20.5)	80.3 (18.7)	71.9 (20.2)
Cost variables (in Can$), mean (SD)				
Medical Services Program	2310 (1610)	4300 (3130)	2580 (1840)	4690 (3350)
Pharmacy costs[c]	1440 (2650)	2020 (3190)	1530 (2590)	1900 (3120)
Hospital costs[c]	2640 (6210)	12,000 (16,700)	4100 (8400)	15,600 (19,100)
Total costs	6390 (7890)	18,300 (19,500)	8210 (10,000)	22,200 (21,900)
Other filter variables, mean (SD)				
General Practitioner services[d]	17.8 (12.1)	28.4 (20.0)	21.5 (14.6)	34.1 (22.0)
Payee numbers[e]	2.8 (1.8)	4.0 (2.7)	2.9 (1.9)	4.4 (2.7)

[a] Minimum age was set by inclusion criterion to 18 years.
[b] See reference 12 for definitions of the categories of communities in British Columbia.
[c] Maximum hospital cost was set by inclusion criterion to Can$100,000.
[d] Minimum value was set by inclusion criterion to 5 general practitioner services per year.
[e] Maximum value was set by inclusion criterion to 25 payee numbers.
1. British Columbia Ministry of Health, Primary Care Data Repository, Fiscal Year 2010-2011.
Can$ = Canadian dollars; RUB = Resource Utilization Band; SD = standard deviation.

relationship between attachment and costs—was present in each age group. Of the physicians' predictors, only the physician's number of payee numbers and years in practice were consistently related to total costs across the conditions. The physician's FTE factor and sex were also related to total costs in all but the chronic kidney disease groups.

The estimates for cost ratio obtained from the generalized linear model analyses, for all 8 chronic conditions at RUBs 4 and 5 from fiscal year 2010-2011, are presented in Figure 1A-H (available online at: www.thepermanentejournal.org/files/Winter2015/CostRatioEstimates.pdf). The cost ratio for a predictor indicates the percentage change in total cost (increase if it is > 1.0; decrease if < 1.0) per dollar spent, if that predictor is increased by 1 unit and holding all other predictors constant. For example, for patients in the diabetes RUB 4 group, a 1% increase in the patient's attachment decreased the total cost by 1.2% (or by Can$0.012 per dollar spent) in 2010-2011 (all other variables held constant), whereas a 1-year increase in age increased the total cost by 0.50%, or Can$0.005 per dollar spent (all other variables held constant).

To summarize the results in Figure 1A-H, attachment to practice was the strongest predictor of total cost in each patient group. For patients with diabetes and CHF, a 1% increase in the patient's attachment reduced the total cost by an estimated Can$1.20 to Can$1.58 per Can$100 dollars spent. Similarly for the other 6 chronic conditions, attachment to practice was consistently related to total cost, with a 1% increase in attachment being associated with Can$1.12 to Can$1.55 per Can$100 spent at RUB 4 and from Can$1.40 to Can$1.77 per Can$100 spent at RUB 5. As for the other 9 predictors, 2 showed consistent results across patient groups. An increase in median household income was consistently associated with decreased costs, whereas the number of years the physician had been in practice was consistently *not* related to cost in all groups. The relationship of costs to the other predictors varied across the various diseases and RUB categories.

Using the cost ratio estimates from the generalized linear model analyses, we estimated the overall health care cost avoidance for a hypothetical situation in which all patients' attachment to a primary care practice was increased by an average of 5%. The total hypothetical

Table 3. Bivariate correlations between total cost and each cost-related predictor variable in 2010-2011 and 2007-2008[a1]

	Diabetes						Congestive heart failure					
	RUB 4			RUB 5			RUB 4			RUB 5		
Predictor variable	2010-2011	2007-2008	z value (p value)[b]	2010-2011	2007-2008	z value (p value)[b]	2010-2011	2007-2008	z value (p value)[b]	2010-2011	2007-2008	z value (p value)[b]
Number	47,611	40,483	–	26,463	22,557	–	20,052	18,697	–	17,123	16,299	–
Patient attachment	-0.1906[c]	-0.179[c]	-1.62 (0.1052)	0.299[c]	-0.282[c]	**-2.01 (0.0444)**	-0.256[c]	-0.238[c]	-1.93 (0.0536)	-0.322[c]	-0.316[c]	-0.58 (0.5619)
Patient age	0.033[c]	0.054[c]	**-3.11 (0.0019)**	0.009[c]	0.004 (NS)	0.53 (0.5961)	-0.018 (NS)	-0.022[c]	0.43 (0.6672)	-0.093[c]	-0.093[c]	0 (> 0.999)
Patient sex	0.022[c]	-0.040[c]	**9.23 (< 0.0001)**	-0.006 (NS)	-0.021[c]	1.71 (0.0873)	0.030[d]	-0.051[c]	**7.96 (< 0.0001)**	-0.003 (NS)	-0.012 (NS)	0.80 (0.4237)
Patient residence	0.005 (NS)	-0.035[c]	**5.93 (< 0.0001)**	-0.029[c]	-0.013[d]	-1.81 (0.0703)	-0.008[c]	-0.023[c]	1.50 (0.1336)	-0.053[c]	-0.023[d]	**-2.75 (0.0060)**
Patient median income	-0.025[c]	-0.041[c]	**2.31 (0.0209)**	-0.026[c]	-0.016[d]	-1.08 (0.2801)	-0.030[c]	-0.038[c]	0.79 (0.4295)	-0.017[c]	-0.021[d]	0.36 (0.7188)
Physician sex	0.007 (NS)	0.004 (NS)	0.49 (0.6241)	0.026[d]	0.010 (NS)	1.73 (0.0819)	0.019 (NS)	-0.016[d]	**3.39 (0.0007)**	0.019[d]	-0.017[d]	0.20 (0.8415)
Physician place of graduation	0.014[c]	0.010[d]	0.59 (0.5552)	0.023[c]	0.016[d]	0.81 (0.4179)	0.009 (NS)	0.003 (NS)	0.61 (0.5419)	0.028[c]	0.025[c]	0.31 (0.7566)
Physician FTE factor	-0.043[c]	-0.024[c]	**-2.83 (0.0047)**	-0.088[c]	-0.036[c]	**-5.78 (< 0.0001)**	-0.049 (NS)	-0.018[d]	**-3.05 (0.0023)**	-0.084[d]	-0.035[c]	**-4.53 (< 0.0001)**
Physician years in practice	-0.017 (NS)	-0.014[d]	0.47 (0.6384)	-0.050 (NS)	-0.029[c]	**-2.33 (0.0198)**	-0.039 (NS)	-0.025[c]	-1.39 (0.1645)	-0.044 (NS)	-0.024[c]	-1.81 (0.0703)
Physician no. of payee numbers	0.054[c]	0.018[c]	**5.32 (< 0.0001)**	0.119[c]	0.068[c]	**5.63 (< 0.0001)**	0.086[c]	0.048[c]	**3.78 (0.0002)**	0.132[c]	0.070[c]	**5.76 (< 0.0001)**

[a] The 2007-2008 correlations are from Hollander et al.[2] Symbols are presented in place of the observed p values in some columns to make the table more readable, in the neo-Fisherian framework,[3] not as indicators of statistical significance of null hypothesis tests that the correlation coefficient equals zero. Boldface values indicate statistically significant differences across time.

[b] The difference between the two correlations was tested using Fisher *r* to z transformation; the p value reported is two-tailed.

[c] p value < 0.001.

[d] p value < 0.05.

1. British Columbia Ministry of Health, Primary Care Data Repository, Fiscal Years 2010-2011 and 2007-2008.

2. Hollander MJ, Kadlec H, Hamdi R, Tessaro A. Increasing value for money in the Canadian healthcare system: new findings on the contribution of primary care services. Healthc Q 2009;12(4):32-44. DOI: http://dx.doi.org/10.12927/hcq.2013.21050.

3. Hurlbert SH, Lombardi CM. Final collapse of the Neyman-Pearson decision theoretic framework and the rise of the neoFisherian. Ann Zool Fennici 2009 Oct;46(5):311-49. DOI: http://dx.doi.org/10.5735/086.046.0501.

FTE = full-time equivalent; NS = not significant (p > 0.05); RUB = Resource Utilization Band.

annual estimated cost avoidance would have been Can$142 million in the 2010-2011 fiscal year (Table 5). A 5% increase is a fairly modest goal and could be achieved if, in a practice, patients with lower attachment levels could be moved to higher attachment levels.

DISCUSSION

Within the continuity of care conceptual framework by Haggerty et al,[1] our study provides an empirical investigation of the cost avoidance associated with the relational continuity of care. Of the 10 patient and physician variables related to health care costs, the patient's attachment to a primary care practice, as a measure of the relational continuity of care, was the strongest and most consistent predictor of health care costs, and the inverse relationship held even after the effects of the other cost-related predictors were taken into account. A 1% increase in a patient's attachment to practice decreased total health care costs by an estimated Can$1.12 to Can$1.77 per Can$100 spent for patients at RUBs 4 and 5 with a range of chronic diseases. Thus, one can conclude that our original findings were robust because they could be replicated over time and across a wider range of different chronic conditions.

The results of our study are limited by a number of factors related to working with administrative databases. First, although we tried to make reasonable assumptions with our inclusion criteria, how patients are entered and remain in the registries may vary across registries. Second, many patients have more than one chronic condition, and comorbidities have an impact on cost estimates. However, additional analyses conducted on the 2010-2011 data, identical to those described in the Introduction (not reported here but available from the authors), showed that the inverse relationship between costs and the patient's attachment to a primary care practice holds consistently whether patients have one or multiple chronic conditions. In this context, we can also add that the inverse relationship held when we examined it separately in subgroups of men and women, different age groups, physician place of graduation, and the other predictor variables. Third, a more general limitation of our study is that the findings are based on databases from one Canadian province. Whereas the dollar amounts will vary, we believe that our main finding of the overall inverse relationship between attachment and cost would be replicated in other jurisdictions. Finally, our results are based on costs to government for medical and hospital services and pharmaceuticals only. The costs do not include health-related payments made by patients themselves or their insurers. Thus, this study focuses on costs to government. Data on private-pay costs for specific individuals were not available for analysis.

Table 4. Bivariate correlation coefficients with total cost for patients with various chronic conditions and health care need levels[a1]

Predictor variable	COPD		Hypertension		Angina		CKD		Osteoarthritis		Stroke	
RUB category	RUB 4	RUB 5	RUB 4	RUB 5	RUB 4	RUB 5	RUB 4	RUB 5	RUB 4	RUB 5	RUB 4	RUB 5
n	23,360	16,528	64,350	27,752	27,703	18,199	16,729	13,862	58,919	31,251	14,767	14,472
Patient attachment to practice	-0.2011[b]	-0.2617[b]	-0.1766[b]	-0.2734[b]	-0.2351[b]	-0.3175[b]	-0.1980[b]	-0.3125[b]	-0.1675[b]	-0.2664[b]	-0.2328[b]	-0.3133[b]
Patient age category	0.0638[b]	0.0205[c]	0.0235[b]	-0.0121[c]	0.0201[b]	-0.0073 (NS)	-0.0135 (NS)	-0.0898[b]	0.0648[b]	0.0589[b]	-0.0054 (NS)	-0.0475[b]
Patient sex	0.0247[b]	0.0027 (NS)	0.0262[b]	-0.0076 (NS)	0.0279[b]	0.0149[c]	0.0152[c]	-0.0410[b]	0.0164[b]	0.0015 (NS)	0.0336[b]	0.0017 (NS)
Patient residence area	0.0124 (NS)	-0.0219[c]	0.0054 (NS)	-0.0180[c]	-0.0138[c]	-0.0395[b]	0.0057 (NS)	-0.0382[b]	0.0041 (NS)	-0.0329[b]	-0.0009 (NS)	-0.0386[b]
Patient median household income	-0.0117 (NS)	<-0.0001 (NS)	-0.0264[b]	-0.0218[b]	-0.0295[b]	-0.0201[c]	-0.0357[b]	-0.0357[b]	-0.0257[b]	-0.0209[b]	-0.0211[c]	-0.0301[b]
Physician sex	0.0207[c]	0.0364[b]	0.0108[c]	0.0224[b]	0.0187[c]	0.0314[b]	-0.0018 (NS)	0.0129 (NS)	0.0081[c]	0.0138[c]	0.0301[b]	0.0310[b]
Physician place of graduation	0.0042 (NS)	0.0198[c]	0.0154[b]	0.0253[b]	0.0118[c]	0.0154[c]	-0.0029 (NS)	0.0230[c]	0.0135[b]	0.0205[b]	0.0122 (NS)	0.0193[c]
Physician FTE factor	-0.0479[b]	-0.0941[b]	-0.0369[b]	-0.0767[b]	-0.0340[b]	-0.0760[b]	-0.0135 (NS)	-0.0577[b]	-0.0317[b]	-0.0706[b]	-0.0679[b]	-0.1185[b]
Physician years in practice	-0.0291[b]	-0.0478[b]	-0.0191[b]	-0.0345[b]	-0.0253[b]	-0.0488[b]	-0.0243[c]	-0.0422[b]	-0.0235[b]	-0.0455[b]	-0.0438[b]	-0.0679[b]
Physician no. of payee numbers	0.0705[b]	0.1443[b]	0.0476[b]	0.1102[b]	0.0421[b]	0.1168[b]	0.0729[b]	0.1331[b]	0.0551[b]	0.1210[b]	0.0981[b]	0.1722[b]

[a] Symbols are presented in place of the observed p values in some columns to make the table more readable, in the neoFisherian framework,[2] not as indicators of statistical significance of null hypothesis tests that the correlation coefficient equals zero.

[b] p value < 0.001.

[c] p value < 0.05.

1. British Columbia Ministry of Health, Primary Care Data Repository, Fiscal Year 2010-2011.

2. Hurlbert SH, Lombardi CM. Final collapse of the Neyman-Pearson decision theoretic framework and the rise of the neoFisherian. Ann Zool Fennici 2009 Oct;46(5):311-49. DOI: http://dx.doi.org/10.5735/086.046.0501.

COPD = chronic obstructive pulmonary disease; CKD = chronic kidney disease; FTE = full-time equivalent; NS = not significant (p > 0.05); RUB = Resource Utilization Band.

Table 5. Estimated potential annual cost avoidance for a 5% increase in attachment to a primary care practice: all patients selected for analyses combined[a1]

RUB category	n	Total health care costs in 2010-2011 (in Can$1M)	Estimated cost ratio per 1% increase in attachment [Exp(B)]	Estimated annual cost avoidance (in Can$1M)[b]
RUB 4	148,646	859.0	0.9882	50.44
RUB 5	74,133	1185.5	0.9845	91.68
Total				142.12

[a] Many patients appear in multiple registries.

[b] Computed as follows: 5 × (Exp(B) − 1) × (Total health care costs).

1. British Columbia Ministry of Health, Primary Care Data Repository, Fiscal Year 2010-2011.

Can$ = Canadian dollars; Exp(B) = exponentiation of the B coefficient, an odds ratio; M = million; RUB = Resource Utilization Band.

Despite these limitations, our study is among the first that *directly* examines the impact that a patient's attachment to his/her primary care practice has on the costs to the health care system. Another strength of our study is the practical definition of continuity of care, which we defined as attachment to practice and operationalized as the percentage of services a patient obtained from his/her most frequently visited primary care practice. As such, it is an empirically derived measure and not a subjective self-report of what a patient may think about their primary care physician. Even with the caveats noted in the preceding paragraph, we believe the relationship between attachment and cost is robust because the estimation models are based on population data, and we found the same results in different groups of high-needs patients with a wide variety of chronic conditions across all of BC.

CONCLUSION

We have shown that the continuity of care, defined as a patient's attachment to his/her primary care practice, can reduce health care costs. We have replicated our previous findings and extended the results to other types of chronic illnesses. In all diseases we examined, increased attachment to a primary care practice was associated with lower costs, even when we controlled for a number of other cost-related variables, such as the patient's age. Thus, health care policy makers may wish to consider creating opportunities for primary care physicians to increase the attachment that their patients with high care needs have to their practices. Our study has shown that even modest increases in attachment can have a substantial potential for cost avoidance.

Regarding future cost-related analyses for higher-care-needs patients, researchers, evaluators, and planners should, on the basis of our findings, consider attachment to a primary care practice as a key driver of health care costs, along with age, sex, level of care need, and other such variables. ❖

Disclosure Statement

Marcus Hollander, MA, MSc, PhD, and Helena Kadlec, MA, PhD, are with Hollander Analytical Services Ltd, Victoria, British Columbia. To ensure the independence and objectivity of evaluations conducted by Hollander Analytical Services, which are funded by the General Practice Services Committee, the British Columbia Ministry of Health and the Doctors of BC have signed an agreement, on behalf of the General Practice Services Committee, that guarantees the integrity, objectivity, and independence of any evaluations conducted for the General Practice Services Committee by Hollander Analytical Services. Thus, the author(s) have no conflicts of interest to disclose.

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