British Columbia Ministry of Health Services and the General Practice Services Committee

Evaluation of the Full Service Family Practice Incentive Program and the Practice Support Program

Final Report on Value-for-Money in Primary Care: The Relationship Between Attachment to Practice and Costs

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CONFIDENTIAL MATERIALS FOR INITIAL DISCUSSION WITH GPSC REGARDING THE ANALYSIS OF ADMINISTRATIVE DATA

The following material is presented to stimulate discussion with GPSC about the analyses we shall be doing for the Full Service Family Practice Incentive Program using administrative data from the Ministry of Health Services. There are numerous ways to analyze the data in regard, for example, to who is, and is not, included in the analyses, and other such matters. Thus, before going too far into our analyses we wanted to discuss some key matters to be addressed in the analyses to ensure that GPSC is comfortable with our proposed approaches.

PLEASE NOTE: The data presented in this material are working, preliminary data. They are not presented as findings as more refinement is required to ensure accuracy and consistency with Ministry protocols. The data are illustrative and are only presented to stimulate discussion about future analyses.

EXECUTIVE SUMMARY

The General Practice Services Committee (GPSC) has contracted with Hollander Analytical Services Ltd. to conduct an evaluation of incentive payments instituted under the Full Service Family Practice Incentive Program (FSFPIP). As part of the project to evaluate the FSFPIP, a range of analyses have been conducted on administrative health data. In conducting these analyses, an interesting relationship emerged which seemed to indicate that patients with a higher level of attachment to their GP actually had lower costs than patients who were less attached. It did, however, appear that the inverse relationship between cost and attachment to practice pertains to those with a moderate to high level of need for health services (i.e., Resource Utilization Bands [RUBs] 3 to 5).

What is interesting, and critical, to the validity of the inverse relationship between attachment to practice and costs is that the same inverse pattern exists within the higher level RUB categories. Thus, the lower cost for patients who have a high attachment to practice is not due to the fact that the patients have lower care needs (i.e., the inverse relationship between costs and attachment to practice continues to hold across different levels of care need, or RUB groups).

Building on our previous work, we have defined a cohort of individuals to whom this inverse relationship could pertain. If it pertains to this group then further analysis and exploration is warranted.

The group we selected consisted of people on the diabetes registry. We then narrowed this group down using the following parameters:

- We limited the analysis to people who were categorized as RUB 4 or 5 to control for the effects of differences in care needs;
- We limited the analysis to people who had at least five GP services in fiscal 2007/08, that is, somewhat heavier care needs patients;
- We excluded people who died in 2007/08 as they would have skewed the data as health care costs are usually quite high for people who die;
- We excluded people in long term care facilities as our focus was on community based primary care;
- We excluded people who were in hospital care for more than 120 days as our focus was on community based clients;
- We defined a practice as a payee number. Thus, this included solo GPs, GPs in groups, drop in clinics, and emergency departments. People have a range of patterns in seeking medical care. There was discussion about emergency departments (actually the payee number of GPs or groups which do a high level of their care in

emergencies) but it was determined that we would leave the patterns open to the range of ways people access medical care; and

- We only included patients if they were seen by GPs (type of practice code 00).

By doing this selection, the number of diabetics was reduced from some 284,400 (Nov. 08 version of the registry) to 52,674.

We also determined a range of variables which could be related to health care costs, and which are available in the administrative data, for inclusion in the analysis. We wanted to include GP level variables in our analysis, as well as patient variables. However, it was not possible to include GP variables for group practices, clinics and so on because we were analyzing attachment to practice. Thus, for each practice, we determined which GP provided most of the care in the practice and used the characteristics of that GP for the set of GP related variables.

With regard to costs, we looked at MSP costs (GPs, specialists, and diagnostic services), hospital costs and PharmaCare costs. These are all costs to government. Thus, the frame for this analysis was "cost to government". Additional analyses would be required to incorporate costs from other parts of the health care system (e.g., home care), and costs to patients and families for co-payments and/or user fees.

The relationship between Attachment to Practice and Total Cost was statistically significant and relatively substantial (some 4.8% of the Total Cost can be explained by Attachment to Practice) but it could be argued that other variables, such as those related to the GPs' training or type of practice, or Patients' demographic characteristics, can account for the decrease in cost by themselves. To examine this possibility, we identified nine variables in the administrative data that we considered could be related to costs, and tested the relationship of Attachment to Practice and Total Cost while taking account of these other GP and Patient cost-related variables. Five GP variables and four Patient variables were identified and tested.

The five GP variables are:

- GP gender (Male, Female, Undisclosed);
- GP's length of practice (0-9, 10-19, 20-29, 30+ years);
- GP's place of graduation (BC, Other Canada, Other Country);
- GP's workload measure as full-time-equivalent (FTE) (0-.74, .75-1.49, 1.50+); and
- The number of payees in the GP's practice (1, 2, 3-4, 5+).

The four Patient variables are:

- Patient Gender;
- Patient Age (as of Sept.1, 2007);
- Patient's Location (Urban Core, Urban Fringe, Rural, Rural Remote, a classification system developed by BC Stats); and
- Patient's Median After-Tax Family Income.

To examine the relationship between Attachment to Practice and Total Cost in the context of each of the GP and Patient variables, we conducted two-way analyses of variance (ANOVAs) using the SAS GLM procedure (General Linear Model).

It was found, overall, that attachment to practice was highly significant, and the strongest predictor of costs when each independent variable was considered in relationship to attachment to practice by itself. It was also found that attachment to practice was the strongest predictor of costs when all independent variables were considered in competition with each other.

The bottom line finding is that the inverse relationship between attachment and cost does, indeed, appear to be a valid relationship. This finding is critical to the work of the GPSC as it shows that good quality primary care can contribute to lower costs in our health care system. Furthermore, it helps to validate the overall purpose of the GPSC to promote better primary care, at least in regard to health care costs, as it demonstrates the increased value-for-money contribution which can be made with full service family practice. Care outcomes are also an important GPSC priority. They will be discussed in other reports to be prepared for the GPSC.

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1. INTRODUCTION

The General Practice Services Committee (GPSC) has contracted with Hollander Analytical Services Ltd. to conduct an evaluation of incentive payments instituted under the Full Service Family Practice Incentive Program (FSFPIP). As part of the project to evaluate the FSFPIP, a range of analyses have been conducted on administrative health data. In conducting these analyses, an interesting relationship emerged which seemed to indicate that patients with a higher level of attachment to their GP actually had lower costs than patients who were less attached. Several analyses were conducted in regard to this finding. Clearly, one possible explanation could be that our finding was an artifact of some other factor. The most likely factor would be the overall care needs of individuals as there is a strong relationship between care needs and care responses, and the costs of these care responses. For medical services there is a classification system developed by John Hopkins University that stratifies people according to the complexity of their care, or care need, called Resource Utilization Bands (RUBs). The classification system goes from 0 to 5. It appears that the inverse relationship between cost and attachment to practice pertains to those with a moderate to high level of need for health services (i.e., RUBs 3 to 5).

What is interesting, and critical, to the validity of the inverse relationship between attachment to practice and costs is that the same inverse pattern exists within the higher level RUB categories. Thus, the lower cost for patients who have a high attachment to practice is not due to the fact that the patients have lower care needs (i.e., the inverse relationship between costs and attachment to practice continues to hold across different levels of care need, or RUB groups).

We also conducted subsequent analyses on the types of patients for whom this inverse relationship exists, and two related concepts, attachment to practice and Majority Source of Care (MSOC). It is our view that attachment to a practice is a better variable than attachment to a particular doctor, although there may be a significant overlap. For example, a patient may go to a group practice in which they may, over a one year period, be seen by their main GP, and other GPs who may fill in for the main GP. Thus, the patient is attached to a given practice even though she/he may see more than one doctor in the practice. The concept of attachment to practice also does not have a requirement to have three or more services as is the case for MSOC.

With MSOC, patients have to have three or more services and have at least 50% of these services with one GP. Thus, the MSOC method does not classify all people into an attachment type of relationship. That is, people who had only one or two GP services, and those with three or more services but less than 50% of their services with one GP, would not be deemed to have a MSOC physician. Thus, while the MSOC approach does link patients and GPs it does not classify all patients. Nevertheless, analyses were conducted which showed the same inverse relationships between attachment and costs, for people who had a MSOC physician. In this analysis the percentage attachment (e.g., 50%-74% and 75%+ attachment) to the MSOC physician was used as a measure of the degree of attachment. Thus, the inverse relationship seems to be robust as it pertained to two types of attachment: attachment to a practice and attachment to a GP.

Another finding was that the inverse relationship pertained primarily to people who had higher level care needs, such as people with chronic conditions. It generally did not pertain to people with no, or fairly modest, care needs (i.e., RUBs groups 0, 1 and 2). There is clearly more analysis which is required in order to better determine for what types of patients the inverse relationships between attachment and costs exists.

What is also required is an analysis to determine if, in fact, the inverse relationship is a valid relationship or if it is a "spurious" relationship, that is, a false relationship because the findings can be explained by some other factor(s). For example, age and income are known to relate to overall health care costs. Thus, could the age variable account for the perceived inverse relationships, that is, is the relationship simply an artifact of different age distributions such that all of the more costly patients are older? If this was the case then the perceived inverse relationship between attachment and cost would simply be an artifact of older people, who cost more, having a lower attachment to practice.

The way to determine if the perceived relationship is a valid relationship is to consider attachment to practice in competition with all other variables which are also related to health care costs. This is what is done in this report. The bottom line finding is that the inverse relationship between attachment and cost does, indeed, appear to be a valid relationship. This finding is critical to the work of the GPSC as it shows that good quality primary care can contribute to lower costs in our health care system. Furthermore, it helps to validate the overall purpose of the GPSC to promote better primary care, at least in regard to health care costs, as it demonstrates the increased value-for-money contribution which can be made with full service family practice.

Finally, the analyses conducted were both statistical and complex. In order to make the report readable for a broader audience, technical details are contained in the footnotes.

2. METHODS

As noted above, more work is required to tease out the extent to which the inverse relationship between attachment and health care costs holds across types of conditions and types of patients. This report represents the first step in that process. Building on our previous findings, we have defined a cohort of individuals to whom this relationship could pertain. If it pertains to this group then further analysis and exploration is warranted.

The group we selected consisted of people on the diabetes registry. We then narrowed this group down using the following parameters:

- We limited the analysis to people who were categorized as RUB 4 or 5 to control for the effects of differences in care needs;

- We limited the analysis to people who had at least five GP services in fiscal 2007/08, that is, somewhat heavier care needs patients;

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We determined a range of variables which could be related to health care costs which were available in the administrative data for inclusion in the analysis. We wanted to include GP level variables in our analysis, as well as patient variables. However, it was not possible to include GP variables for group practices, clinics and so on because we were analyzing attachment to practice. Thus, for each practice, we determined which GP provided most of the care in the practice and used the characteristics of that GP for the set of GP related variables.

With regard to costs, we looked at MSP costs (GPs, [specialists and diagnostic services], hospital costs and PharmaCare costs). These are all costs to government. Thus, the frame for this analysis was “cost to government”. Cost data are limited to MSP, hospital and PharmaCare costs. Additional analyses would be required to incorporate costs from other parts of the health care system (e.g., home care), and costs to patients and families for co-payments and/or user fees.

In the following section we present the results of our analyses. We look at the relationship between attachment to practice and each of the other variables (collapsed into groups) in regard to the costs of care. The results indicate that the inverse relationship between attachment and costs remained valid. For example, the same inverse pattern held for each of the age groups used in the analysis. Finally, we conducted analyses on all variables in combination. This analysis verified that the inverse relationship appears to be a true and valid relationship and is not an artifact of other factors.

3. FINDINGS

3.1 Introduction

To convince ourselves that patients' Attachment to Practice was indeed related to the Cost of care, we examined this relationship in a series of steps that we report here. First, we report how the patients' Attachment to Practice is related to the various cost components, computed in dollars per patient. The cost variables that we consider here are: hospital cost per patient, MSP cost per patient, and PharmaCare cost per patient. We also report the Total Cost per Patient, computed as the sum of these three costs. Because we know that cost is related to a number of variables other than Attachment to Practice, we next wanted to see whether this relationship still held when other cost-related variables were accounted, or controlled, for. To that end, in the second step of our analyses, we identified several variables in the data set that characterize the GPs and the patients and that could be related to cost, and examined the key relationship between Attachment to Practice and (total) Cost as a function of each of these other cost-related variables. These analyses allow us to look at the relationship between Attachment to Practice and Total Cost after removing the influences of each of the other variables. In the final step of our examination reported here, we conducted one overall analysis of the Total Cost with all of the cost-related variables, and Attachment to Practice, together. As we will explain below, this last step was done in order to "control for" any influences that the cost-related variables may have on Cost, in addition to the Attachment to Practice, when their influences are examined together.

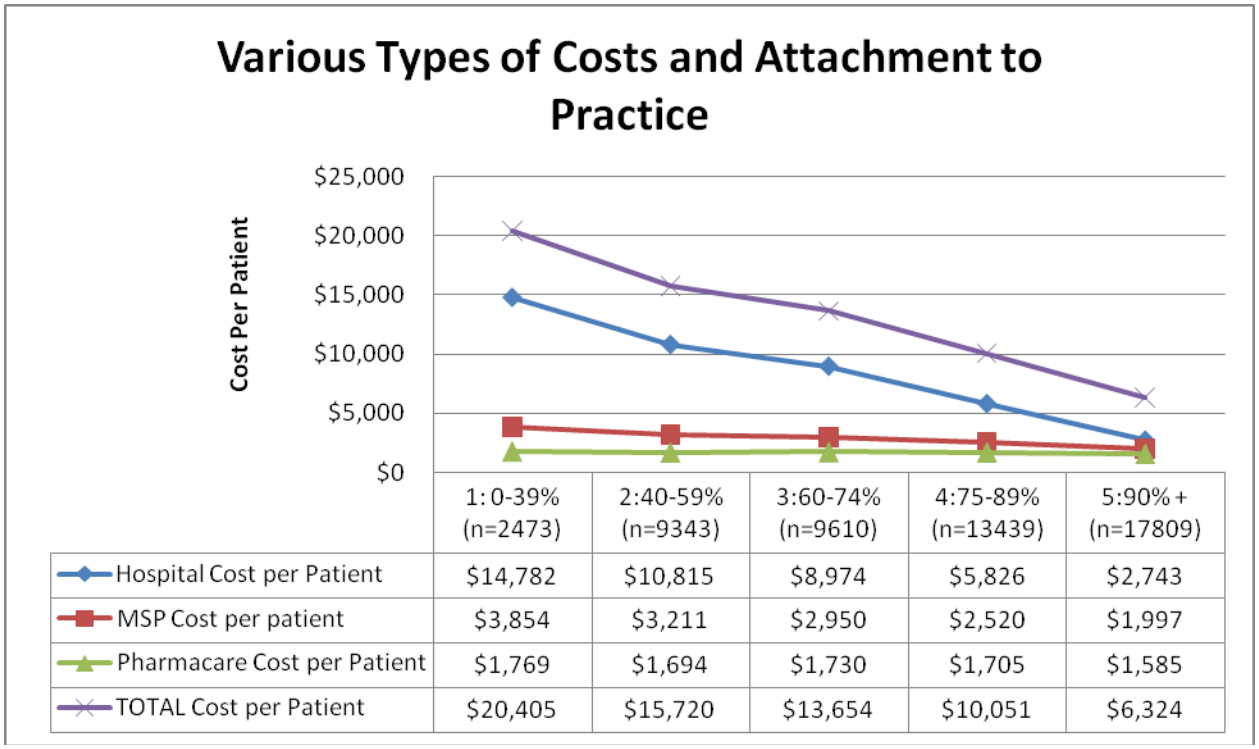
3.2 The Relationship of Attachment to Practice and Costs

Attachment to Practice is computed for each patient and is a percentage value that can range from 1 to 100%. In order to simplify our analyses and interpretations, we grouped people into five subgroups based on their Attachment to Practice score as follows: 1-39%, 40-59%, 60-74%, 75-89%, and 90+%. Figure 1 below shows how each of the Costs decreases with the patients' Attachment to Practice scores.

The graph and table clearly show that increasing patients' Attachment to Practice is related to decreasing costs. Of all the different costs, the weakest relationship is with PharmaCare Cost where the average cost per patient remains fairly consistent at around $1700 per patient per year. The graph also shows that Hospital Costs contribute by far the most to the Total Cost and, thus, to the substantial decrease in Total Cost as a function of increasing Attachment to Practice.[1] It is also interesting to note that the largest drop within each type of cost is between the lowest two levels of Attachment to Practice: In other words, the largest cost decrease was obtained with patients in the lower ranges of Attachment to Practice.

[1] To test whether this effect was statistically significant, a one-way analysis of variance (ANOVA) was conducted with Attachment to Practice as the independent variable and each of the different types of costs as the dependent variable. For the Total Cost, the relationship was statistically significant with $F(4,52716) = 652.79$, $p<.0001$, with 4.7% of the Total Cost variance explained by Attachment to Practice (Model $R^2=.0472$). For the Hospital Cost, the relationship was statistically significant with $F(4,52716) = 578.26$, $p<.0001$, and $R^2=.0420$. For the MSP Cost, the relationship was statistically significant with $F(4,52716) = 763.07$, $p<.0001$, and $R^2=.0547$. And for the Pharmacare Cost, the relationship was also statistically significant with $F(4,52716) = 7.14$, $p<.0001$, but substantially weaker with $R^2=.0005$.

Figure 1: Mean Costs per Patient as a Function of Patients' Attachment to Practice Score



	1: 0-39% (n=2473)	2:40-59% (n=9343)	3:60-74% (n=9610)	4:75-89% (n=13439)	5:90%+ (n=17809)
Hospital Cost per Patient	$14,782	$10,815	$8,974	$5,826	$2,743
MSP Cost per patient	$3,854	$3,211	$2,950	$2,520	$1,997
Pharmacare Cost per Patient	$1,769	$1,694	$1,730	$1,705	$1,585
TOTAL Cost per Patient	$20,405	$15,720	$13,654	$10,051	$6,324

3.3 Attachment to Practice and Cost in the Context of Other Cost-Related Variables

3.3.1 Introduction

The relationship between Attachment to Practice and Total Cost was statistically significant and relatively substantial (some 4.8% of the Total Cost can be explained by Attachment to Practice) but it could be argued that other variables, such as those related to the GPs' training or type of practice, or Patients' demographic characteristics, can account for the decrease in cost by themselves. To examine this possibility, we identified nine variables in the data set that we considered would be related to costs, and tested the relationship of Attachment to Practice and Total Cost while taking account of these other GP and Patient cost-related variables. Five GP variables and four Patient variables were identified and tested.

The five GP variables are:

- GP gender (Male, Female, Undisclosed);
- GP's length of practice (0-9, 10-19, 20-29, 30+ years);
- GP's place of graduation (BC, Other Canada, Other Country);
- GP's workload measure as full-time-equivalent (FTE) (0-.74, .75-1.49, 1.50+); and

- The number of payees in the GP's practice (1, 2, 3-4, 5+).

The four Patient variables are:

- Patient Gender;
- Patient Age (as of Sept.1, 2007);
- Patient's Location (Urban Core, Urban Fringe, Rural, Rural Remote, a classification system developed by BC Stats); and
- Patient's Median After-Tax Family Income.

To examine the relationship between Attachment to Practice and Total Cost in the context of each of these GP and Patient variables, we conducted two-way analyses of variance (ANOVAs) using the SAS GLM procedure (General Linear Model)[2]. The advantage of this statistical procedure is that it tests the effect of the Attachment to Practice on Total Cost alone as well as in combination with the other GP or Patient Cost-related variable. In these two-way GLMs, the test of the Attachment to Practice by itself is interesting because it tests whether the relationship between Attachment to Practice and Total Cost per Patient remains statistically significant even after we include the second variable that can account for the Total Cost Per Patient changes.[3] The test of the interaction effect in these two-way ANOVA/GLM analyses is also interesting because, for each GP or Patient variable, it tests whether the relationship between Attachment to Practice and Total Cost changes as a function of changes in that other variable.

3.3.2 GP Variables

3.3.2.1 GP Gender

[2] We conducted several different analyses here, including multiple regressions (treating Attachment to Practice and where appropriate the GP or Patient variables as continuous predictors) or ANCOVAs, again as appropriate. The results, in terms of statistical significance and strength of relationship were very similar across the different analyses (as would be expected). The reason we report the two-way ANOVAs here is to help us present our interpretation and description of the results (by using sub-groupings and reporting the group means) in a more straightforward manner. In addition, the ANOVAs allow us to test the two-way interaction effects of the Attachment to Practice with each of the GP and Patient variables.

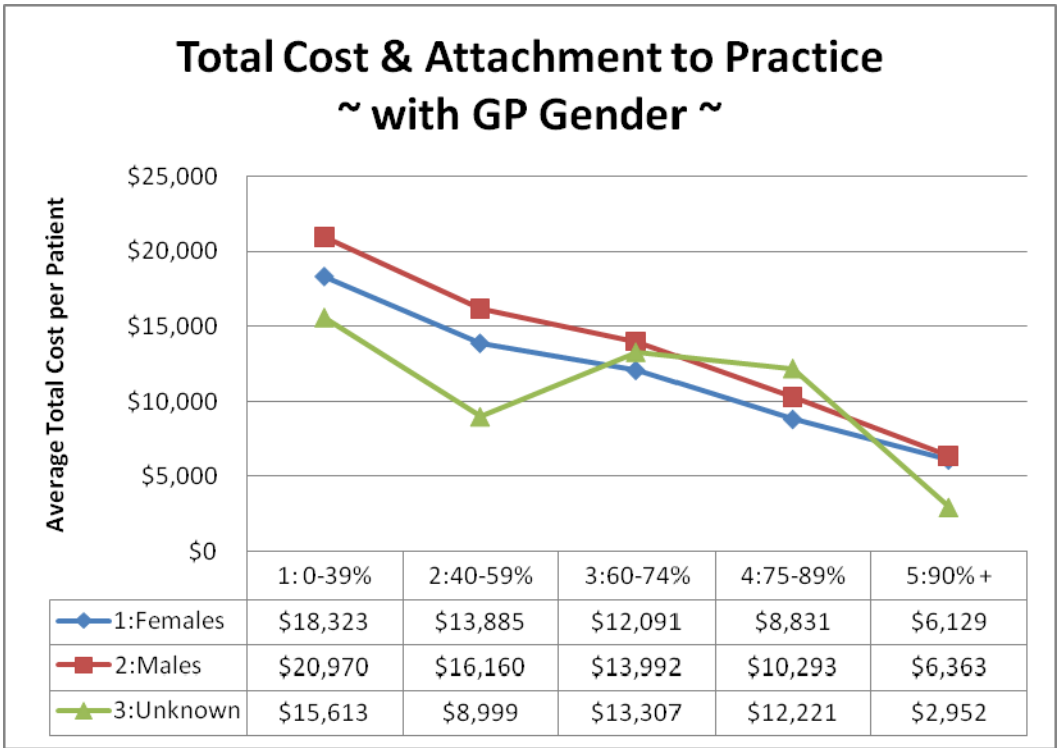
[3] Each two way GLM analysis of variance in the following tables contains two types of ANOVA summary tables, one using Type I SS and one using Type III SS for computing the F-value. The Type I SS is used in a hierarchical computational procedure, where the first effect entered into the model (in our case always Attachment to Practice) contributes its unique variance and all of the variance it shares with all the remaining effects in the model. This value, therefore gives the total variability in the Total Cost variable that Attachment to Practice can explain. It will be the same in all of the GLM analyses reported in this section (since Attachment to Practice was always entered first into the model), and it is also equal to the one-way ANOVA result reported in the previous section where this was the only variable in the model.

The second ANOVA table, based on Type III SS, is more interesting in this context because it gives the **unique** contribution of each effect that is tested in the model. In this situation, to the extent that the predictors are themselves correlated, which they are in an unbalanced ANOVA design such as ours the F-value tests the significance for the relationship of the given predictor after the influences of **all** the other predictors in the model (here these are the GP or Patient variable and the interaction between Attachment to Practice and the other variable) are removed. This test, therefore, is the key one to seeing whether or not Attachment to Practice remains significant even after removing the effects of the other Cost-related variable, and it is these results that will be reported.

The gender of the GP (Male, Female, Undisclosed) does have a significant effect on Total Cost, with patients seeing men physicians incurring, on average, a higher cost per patient (M=$11,116) than those who see women physicians (M=$10,105). The 43 patients who saw physicians for whom the gender data are missing were in between with an average of $10,567 per patient.[4] When we look at the interaction between Attachment to Practice and GP Gender (see graph below), this is also statistically significant, and we see that the cost differential between male and female physicians is greatest for patients in the lower Attachment to Practice groups and is very small in the highest Attachment to Practice group (where there are also the largest number of patients).

Of primary interest to us, however, is that the Attachment to Practice does remain a statistically significant contributor to the Total Cost ($F(4, 52706) = 2.91$, $p=.0202$), and accounts for 0.02% of the variance in the Total Cost even when we control for the effects of GP's Gender. This is a relatively weak effect, but when looked at in terms of real dollars could amount to a substantial amount.

Figure 2: Total Cost and Attachment to Practice with GP Gender



	1: 0-39%	2:40-59%	3:60-74%	4:75-89%	5:90% +
1:Females	$18,323	$13,885	$12,091	$8,831	$6,129
2:Males	$20,970	$16,160	$13,992	$10,293	$6,363
3:Unknown	$15,613	$8,999	$13,307	$12,221	$2,952

3.3.2.2 GP's Length of Practice

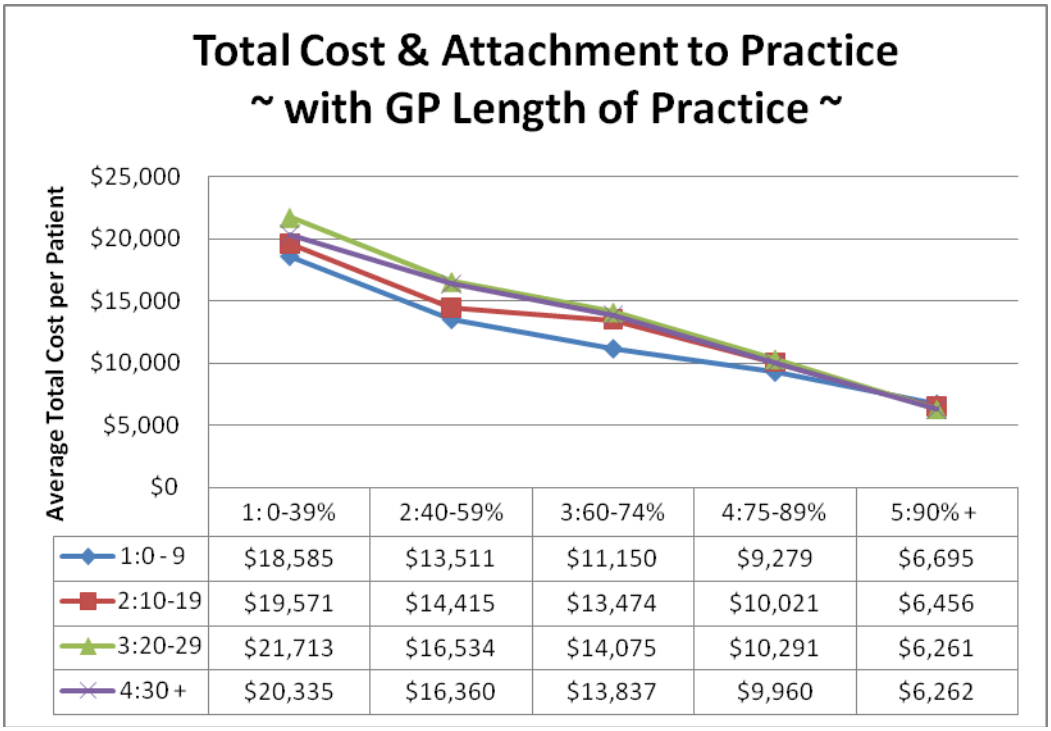
The length of practice was measured in years, but once again for ease of explanation and description, we grouped this variable into decades. The length of practice has a very small effect

[4] The main effect of GP gender was statistically significant, with $F(2, 52706) = 22.40$, $p<.0001$, based on Type III SS (see footnote 3). For the interaction effect of GP Gender and Patient's Attachment to Practice, $F(8, 52706) = 2.16$, $p=.0276$. R^2 for the model = .0483, and root MSE = 18502.0.

on the Total Cost, with GPs in practice longer incurring slightly higher costs overall – overall means were $11,199 and $10,843 for GPs in practice for 20-29 years and 30+ years, respectively, and $10,729 and $10,769 for GPs in practice for 0-9 and 10-19 years, respectively. Similarly, the joint effect of GP's Length of Practice and Patient's Attachment to Practice on Total Cost was small but statistically significant, with larger group differences in Total Cost at the lower to mid-range of Attachment to Practice. Importantly for us, in the context of this variable, Attachment to Practice remained highly statistically significant ($F(4,52701) = 361.54$, $p<.0001$) and relatively strong, accounting for 2.6% of the total variability in Total Cost when the effects of GP's Length of Practice were removed.[5]

Graduation controlled for, Attachment to Practice uniquely explained 4.75% of the Total Cost variability (almost all of the variability explained by the model), which is a strong and reliable effect, even when the influences of GP's Place of Graduation on the Total Cost are removed.

Figure 3: Total Cost and Attachment to Practice with GP Length of Practice



	1: 0-39%	2:40-59%	3:60-74%	4:75-89%	5:90% +
1:0 - 9	$18,585	$13,511	$11,150	$9,279	$6,695
2:10-19	$19,571	$14,415	$13,474	$10,021	$6,456
3:20-29	$21,713	$16,534	$14,075	$10,291	$6,261
4:30 +	$20,335	$16,360	$13,837	$9,960	$6,262

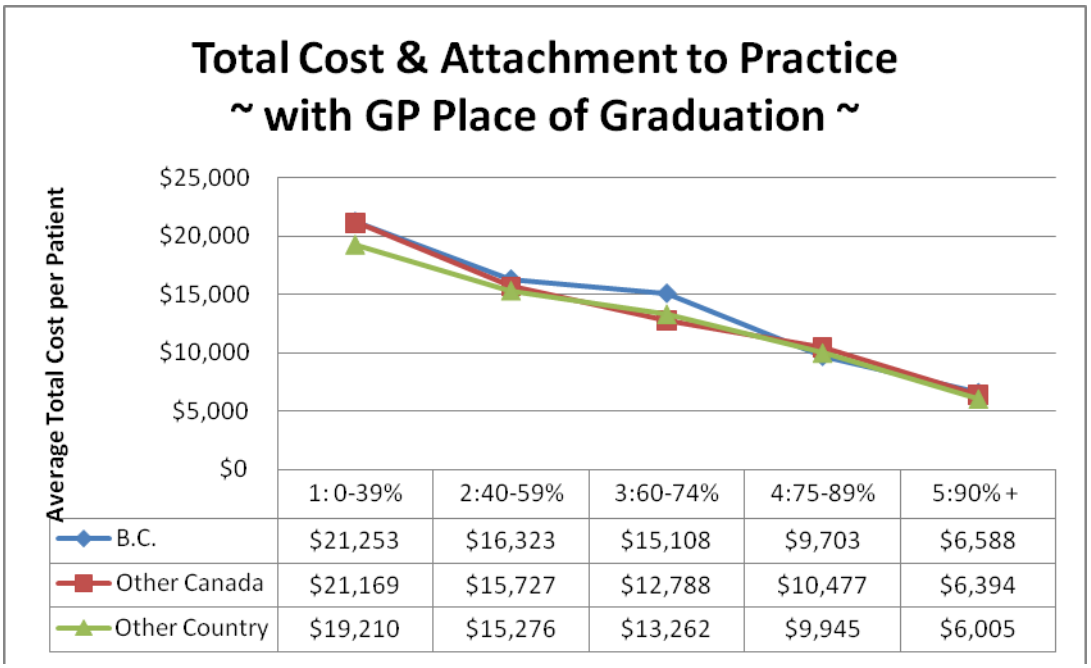
3.3.2.3 GP's Place of Graduation

Three areas of GP's Place of Graduation were identified as: BC, Other Canada, Other Country. This variable also had an overall effect on the Total Cost per Patient, with GPs

[5] The main effect of GP Length of Practice was statistically significant, with $F(3, 52701) = 9.79$, $p<.0001$, based on Type III SS (see footnote 3). For the interaction effect of GP Length of Practice and Patient's Attachment to Practice, $F(12, 52701) = 2.76$, $p=.0009$). R^2 for the model = .0482.

graduating in BC incurring on average slightly higher average Total Cost per Patient (M=$11,169) than those graduating in other parts of Canada (M=$10,851) who were very similar to those graduating in Other Countries (M=$10,829). These differences were statistically significant but the overall effects of this variable, alone and in combination with the Attachment to Practice, were both relatively weaker than the unique effect of Attachment to Practice, after removing the effects of this variable ($F(4,52706) = 656.79$, $p<.0001$).[6] With GP's Place of Graduation controlled for, Attachment to Practice uniquely explained 4.75% of the Total Cost variability (almost all of the variability explained by the model), which is a strong and reliable effect.

Figure 4: Total Cost and Attachment to Practice with GP Place of Graduation



	1: 0-39%	2: 40-59%	3: 60-74%	4: 75-89%	5: 90% +
B.C.	$21,253	$16,323	$15,108	$9,703	$6,588
Other Canada	$21,169	$15,727	$12,788	$10,477	$6,394
Other Country	$19,210	$15,276	$13,262	$9,945	$6,005

3.3.2.4 GP's Workload Measure as Full-Time-Equivalent (FTE Factor)

We considered that the GP's FTE Factor may also be related to Cost. Once again, this variable was measured as a continuous variable which we categorized into three groups – those with FTE of 0-.74, .75-1.49, and 1.50 and more (1.50+) – for ease of explanation, and also because this variable was highly negatively skewed (very few of these patients seeing GPs at the low end of the FTE Factor range). We evaluated the influence of this variable on the Total Cost, and found that patients seeing GPs with a higher FTE Factor had, on average, lower Total Cost (M=$12,649, $11,141 and $10,382 for the 0.74, 0.75-1.50, and 1.50+ groups, respectively). These overall group differences were not statistically significant.[7] The Patient's Attachment to

[6] The main effect of GP Place of Graduation had $F(2, 52706) = 9.28$, $p<.0001$, based on Type III SS (see footnote 3). For the interaction effect of GP Place of Graduation and Patient's Attachment to Practice, $F(8, 52706) = 3.81$, $p=.0002$). R^2 for the model = .0480.

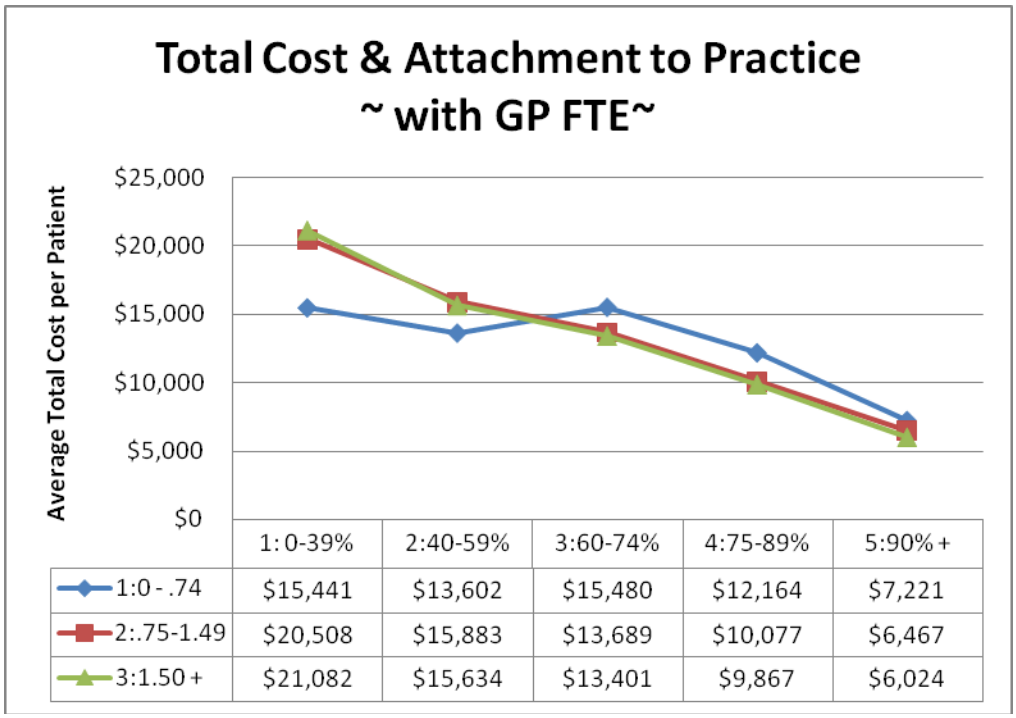
[7] The main effect of GP FTE Factor was not statistically significant, with $F(2, 52706) = <1$. For the interaction effect of GP FTE and Patient's Attachment to Practice, $F(8, 52706) = 2.83$, $p=.0038$). R^2 for the model = .0357 and root MSE = 18507.

Practice effect, with the influences of the FTE variable removed, was reliable ($F(4,52706) = 104.43$, $p<.0001$) and relatively strong, uniquely accounting for 0.76% of the variance in Total Cost.

The graph below shows that the Total Cost for patients who saw GPs with an FTE Factor of 0.75 or higher dropped identically as a function of their Attachment to Practice: the two groups had almost identical means across the whole range. The Total Cost for patients of GPs with a FTE Factor of 0.74 or less was less affected by the change in Attachment to Practice, and only began to drop for those patients with higher levels of Attachment (75% or higher).

It should be noted here, however, that the number of patients with GPs in this low-FTE group was by far the smallest, with a sample size of only 1,297 compared with those in the middle group (n=34,826) and the high-FTE group (n=16,551). Caution must be used in interpreting results with such very unequal sample sizes, both in terms of importance of the statistical tests (because highly unbalanced designs may produce spurious results) as well as the "real" significance of the results in terms of real dollars.

Figure 5: Total Cost and Attachment to Practice with GP FTE



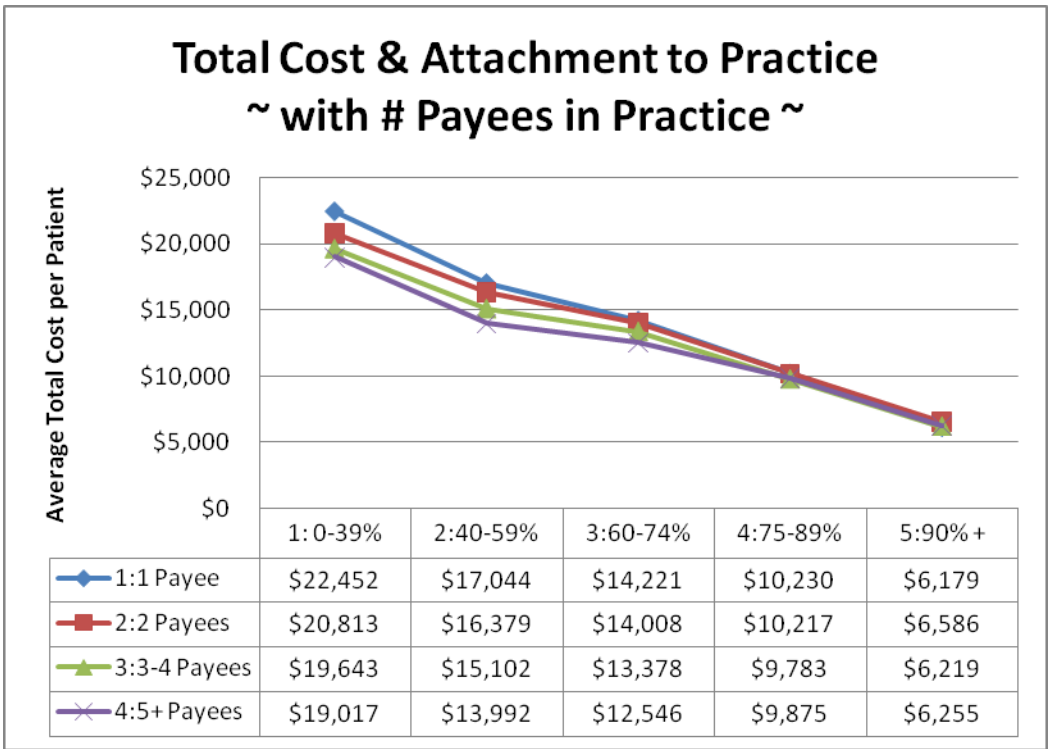
	1:0-39%	2:40-59%	3:60-74%	4:75-89%	5:90%+
1:0-.74	$15,441	$13,602	$15,480	$12,164	$7,221
2:.75-1.49	$20,508	$15,883	$13,689	$10,077	$6,467
3:1.50+	$21,082	$15,634	$13,401	$9,867	$6,024

3.3.2.5 The Number of Payee Numbers

The final GP variable was the number of payee numbers that GPs had. Because this variable was very highly positively skewed (only a small number of GPs had a large number of payee numbers), we categorized this variable into 1, 2, 3-4, or 5 or more (5+) payee number groups. The influences of this variable on the Total Cost can be seen in the graph and table below. As we saw with the majority of the other GP variables, as Attachment to Practice

increases, the Total Cost drops, and this holds for each of the Payee groups. Another finding here is that GPs with fewer payee numbers have a higher Total Cost for patients at the lower end of the Attachment to Practice range; conversely, there is hardly any difference in Total Costs at the highest level of Attachment to Practice.[8]

Figure 6: Total Cost and Attachment to Practice with Number of Payee Numbers



	1: 0-39%	2:40-59%	3:60-74%	4:75-89%	5:90% +
1:1 Payee	$22,452	$17,044	$14,221	$10,230	$6,179
2:2 Payees	$20,813	$16,379	$14,008	$10,217	$6,586
3:3-4 Payees	$19,643	$15,102	$13,378	$9,783	$6,219
4:5+ Payees	$19,017	$13,992	$12,546	$9,875	$6,255

3.3.3 Patient Variables

3.3.3.1 Patient Gender

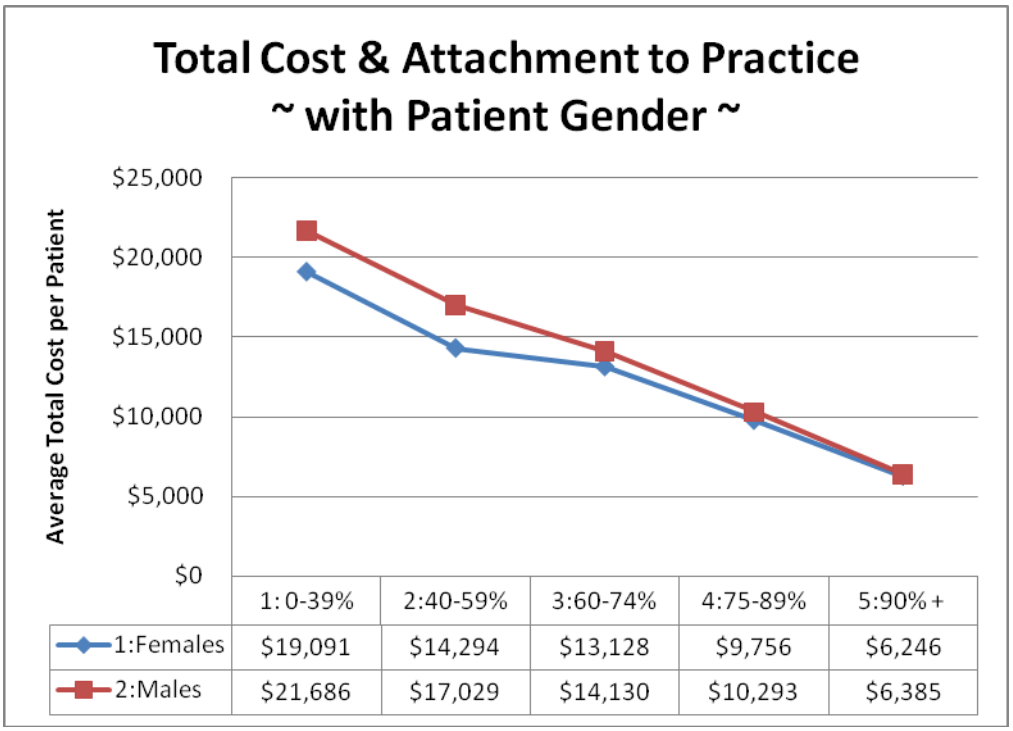
There were almost equal numbers of men and women in this sample, with 24,151 women and 28,523 men. Their overall mean Total Cost per patient differed, with women averaging $10,567 per patient and men averaging $11,256 per patient. The way that Attachment to Practice related to Total Cost also differed for the two genders, as can be seen in the graph and table below: For the lower three groupings of Attachment to Practice, male patients experienced a faster drop in Total Cost than female patients. By the time they reached the high end of the Attachment to Practice range, the two groups did not differ.[9] After removing the influences due

[8] The interaction of Attachment to Practice and Payee group was weak but statistically significant, F(12, 52701) = 2.38, p=.0045, and the main effect of Payee group was only slightly stronger, F(3, 52701) = 12.36, p<.0001). With both of these effects removed, the Attachment to Practice remained highly significant (F(4, 52701) = 594.05, p,>0001) and relatively strong accounting for 4.3% of the variability in Total Cost. The R^2 for the model = .0482, and root MSE = 18503.2.

[9] The main effect of Patient Gender was statistically significant, F(1, 52711) = 48.04, p<.0001) and the interaction of Patient Gender and Attachment to Practice was also statistically significant, F(1, 52711) = 9.23, p<.0001). The main effect of Attachment to Practice, after removing the other model effects remained statistically significant, F(4,

to the Patient's Gender from the Total Cost, the influence of Attachment to Practice on Total Cost remained highly reliable and strong (the Attachment to Practice alone accounted for 4.66% of the variance in Total Cost, which is 96% of all of the variance that we can explain with these two variables).

Figure 7: Total Cost and Attachment to Practice with Patient Gender



	1: 0-39%	2:40-59%	3:60-74%	4:75-89%	5:90% +
1:Females	$19,091	$14,294	$13,128	$9,756	$6,246
2:Males	$21,686	$17,029	$14,130	$10,293	$6,385

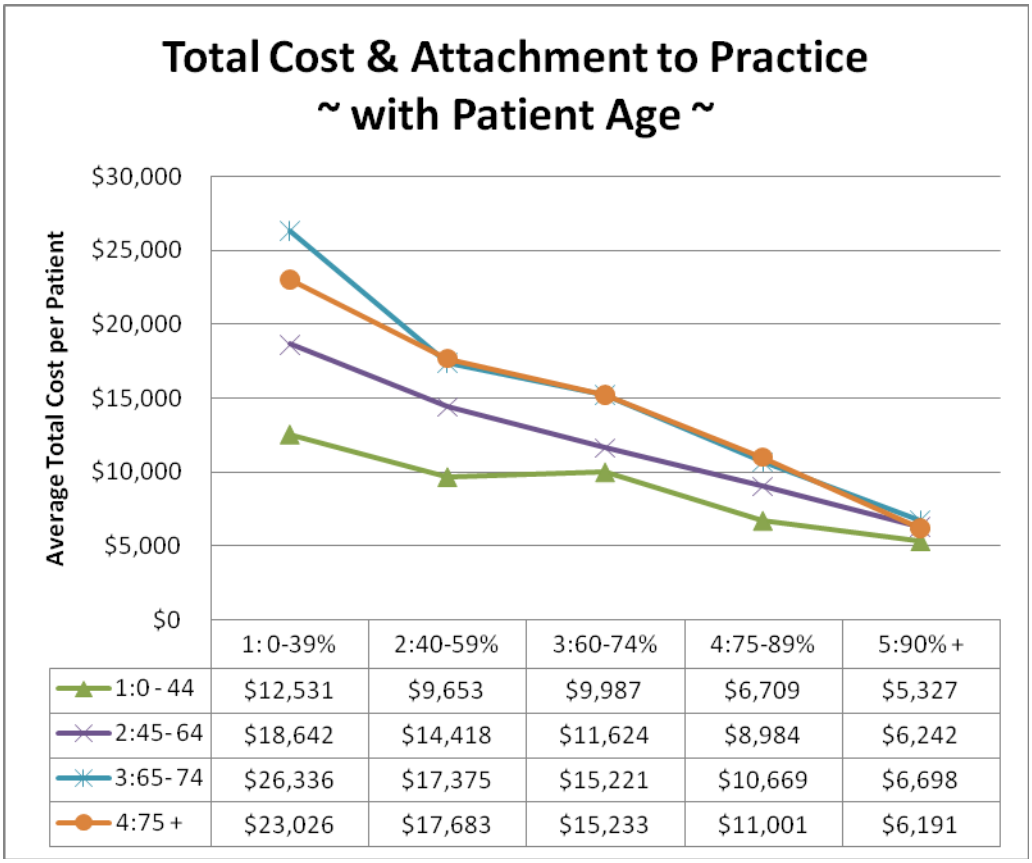
3.3.3.2 Patient Age

Patient's Age is also related to cost. Once again, we grouped this continuous variable into four categories – patients 44 and younger formed one group, those 45-64 a second group, 65-74 year-olds were a third group, and those 75 and older were the fourth group – to help us see the relationships between the three variables. In the graph and table below, we can again see that the decrease in Total Cost with increasing Attachment to Practice holds in each of these Age groups. The Patient's Age alone, and its combined effect with Attachment to Practice, were both significant contributors to Total Cost, but even with their influences removed, Attachment to Practice alone remained highly significant ($F, 4, 32701) = 392.10$, $p<.0001$) and relatively strong, explaining 2.8% of the variance in Total Cost.[10]

52711) = 645.28, p<.0001) as well as relatively strong, accounting for 4.7% of the variance in Total Cost, which is almost all of the variance explained by the model (model $R^2 = .0485$).

[10] The main effect of Patient Age was statistically significant, $F(3, 52701) = 131.47$, $p<.0001$) and the interaction of Patient Age and Attachment to Practice was also statistically significant, $F(12, 52701) = 13.39$, $p<.0001$). The main effect of Attachment to Practice in this context, after removing the other model effects remained statistically significant, $F(4, 52701) = 392.10$, $p<.0001$) as well as relatively strong, accounting for 2.8% of the variance in Total Cost, which is about half of the variance explained by the entire model (model $R^2 = .0562$).

Figure 8: Total Cost and Attachment to Practice with Patient Age



	1: 0-39%	2:40-59%	3:60-74%	4:75-89%	5:90% +
1:0 - 44	$12,531	$9,653	$9,987	$6,709	$5,327
2:45- 64	$18,642	$14,418	$11,624	$8,984	$6,242
3:65- 74	$26,336	$17,375	$15,221	$10,669	$6,698
4:75 +	$23,026	$17,683	$15,233	$11,001	$6,191

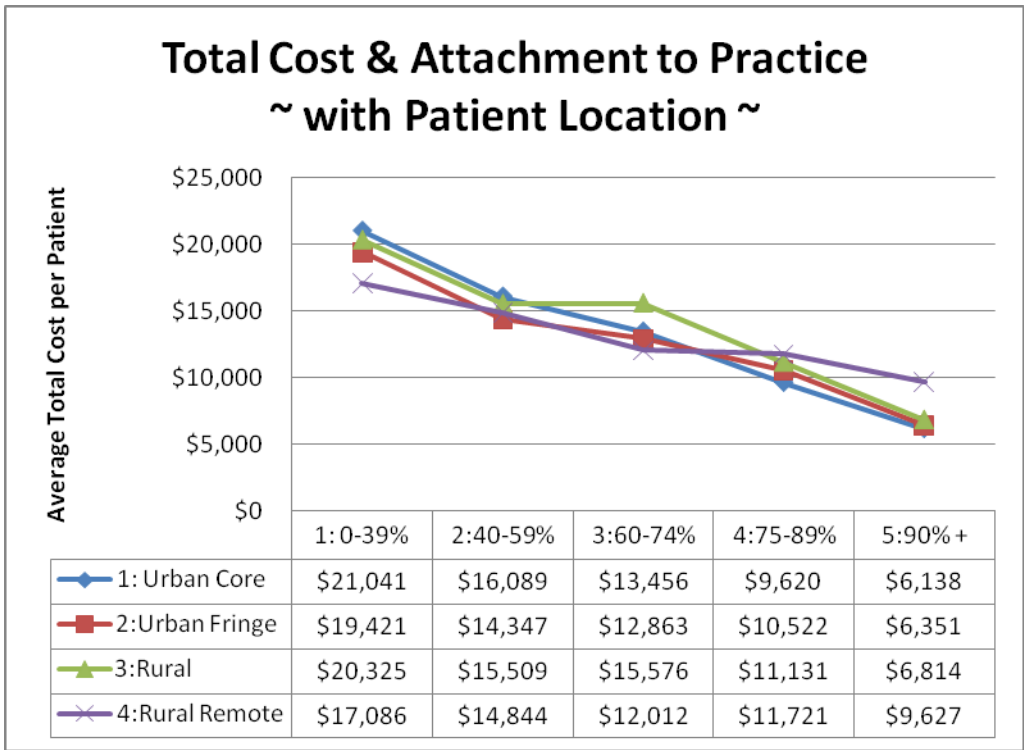
3.3.3.3 Patients' Location

Where the patient resides is another potentially cost-related variable. Four types of locations were identified: Urban Core, Urban Fringe, Rural, and Rural Remote. These categories were developed by BC Stats. The average Total Cost across these four groups did differ, with the two Urban groups having lower average Total Costs per Patient (M=$10,639 and $10,611 for Urban Core and Urban Fringe, respectively) than the two Rural groups (M=$12,234 and $12,668 for Rural and Rural Remote, respectively).

The influence of this variable on the relationship between Attachment to Practice and Total Cost was examined and the group means are shown in the graph and table below. Once again, the pattern of decreasing Cost with increasing Attachment to Practice is present, and holds consistently in each of the Locations. An interesting finding here is that the Rural Remote group, whose Total Cost has the smallest range across the Attachment to Practice groups (the decrease is from $17,086 to $9,627), nevertheless shows the same pattern of consistently decreasing Total Cost with increasing Attachment to Practice.[11]

[11] The main effect of Patient Location was statistically significant but weak, $F(3, 52601) = 3.14$, $p=.0243$) and the interaction of Patient Location and Attachment to Practice was also statistically significant, $F(12, 52601) = 4.95$, $p<.0001$). Once again, the main effect of Attachment to Practice in this context, after removing the other model effects remained highly statistically significant, $F(4, 52601) = 183.43$, $p<.0001$) as well as moderately strong,

Figure 9: Total Cost and Attachment to Practice with Patient Location



	1: 0-39%	2:40-59%	3:60-74%	4:75-89%	5:90% +
1: Urban Core	$21,041	$16,089	$13,456	$9,620	$6,138
2:Urban Fringe	$19,421	$14,347	$12,863	$10,522	$6,351
3:Rural	$20,325	$15,509	$15,576	$11,131	$6,814
4:Rural Remote	$17,086	$14,844	$12,012	$11,721	$9,627

3.3.3.4 Patient's Median After-Tax Family Income

The Patient's Income is the final cost-related variable we examine in this report, and again for ease of explanation, we grouped together patients with median incomes (based on the median family income of the forward sortation area, that is, the first three digits of the postal code, where the patient lived) of less than $50,000 (n=12,545), $50,000 to $59,999 (n=23,725), and $60,000 or more (n=16,404). For these Income groups, the average Total Cost per Patient was found to differ slightly, with the lowest Income group averaging $11,503 per patient, the middle Income group averaging $10,958, and the highest Income group averaging $10,482.

The influence of this patient variable on the Attachment to Practice and Total Cost was the weakest of the entire set, and in fact its influence on the relationship was not significant.[12]

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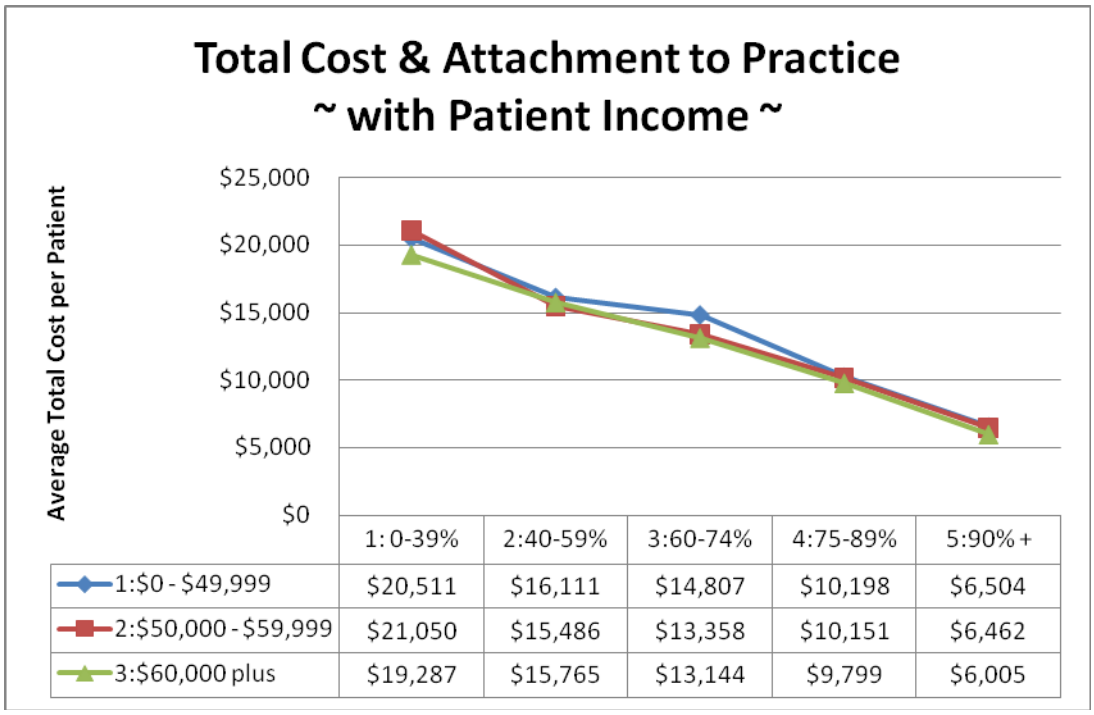
accounting for 1.3% of the variance in Total Cost, which is about 25% of the variance explained by the entire model (model R^2 = .0485).

[12] The main effect of Patient Income was statistically significant but weak, $F(2, 52706) = 4.64$, $p=.0097$) and the interaction of Patient Income and Attachment to Practice was not statistically significant, $F(8, 52706) = 1.50$, $p=.1507$). Once again, the main effect of Attachment to Practice in this context, after removing the other model effects remained highly statistically significant, $F(4, 52601) = 614.86$, $p<.0001$) as well as quite strong, accounting for 4.44% of the variance in Total Cost, which is about 93% of the variance explained by the entire model (model R^2 = .0476).

Figure 10: Total Cost and Attachment to Practice with Patient Income



	1: 0-39%	2:40-59%	3:60-74%	4:75-89%	5:90% +
1:$0 - $49,999	$20,511	$16,111	$14,807	$10,198	$6,504
2:$50,000 - $59,999	$21,050	$15,486	$13,358	$10,151	$6,462
3:$60,000 plus	$19,287	$15,765	$13,144	$9,799	$6,005

3.3.3.5 Summary

Of the nine variables that we identified as being related to the Total Cost, several variables clearly have no, or little, influence on the relationship between Attachment to Practice and Total Cost. These include GP Place of Graduation, the Number of Payees in the GP's Practice, the Patient's Gender and Patient's Income.[13] Variables that moderately influence the relationship are GP's Length of Practice, GP's FTE, Patient's Age and Patient's Location. Of this set, and using these analyses and criteria, it seems that the strongest influence on the Attachment to Practice and Total Cost relationship was exerted by GP Gender.

4. ATTACHMENT TO PRACTICE AND COST WITH ALL COST-RELATED VARIABLES CONSIDERED TOGETHER

To get a more complete picture of the relationship between Attachment to Practice and Total Cost (noted in the previous section) we looked at this relation as a function of nine other cost-related variables, one at a time. This, however, raises the question of whether Attachment

[13] This assessment is based on the comparison in % variance in Total Cost explained by (a) the full model (typically approximately 4.8% in each GLM reported here) and (b) the Attachment to Practice variable following the removal of effects of the other variables in the model. If the % variance explained by Attachment to Practice remained close to 4.8%, the other variable was deemed as not influencing the relationship between Attachment to Practice and Total Cost. However, the smaller this value, the more of the explained variability was "taken away" from Attachment to Practice by the other variable and thus the stronger the influence that the other variable had on the relationship between Attachment to Practice and Total Cost.

to Practice remains related to Total Cost when all of the cost-related variables are considered together. Perhaps when one controls for these one at a time, the relationship remains strong; however when the other variables are considered together, or in competition with, attachment to practice, the relationship may go away. For example, it could be that some combination of the GP and patient characteristics together could explain the drop in Total Cost we see with the Attachment to Practice variable.

To examine this possibility, we conducted a number of multiple regression analyses with Attachment to Practice and the nine other Cost-related variables as predictors (coded appropriately) and Total Cost as the criterion variable. This is one way to compare how Attachment to Practice fares in the context of the other variables. One of the main results from a multiple regression analysis is how much (i.e., the proportion) of the variability in the "criterion variable", which is Total Cost in this report, can be explained by all the "predictor" variables put into the analysis to predict that criterion variable. By comparing the proportions of variability explained across different analyses with different subsets of predictor variables, we can then assess the contribution of the remaining predictor variable(s).

For our analyses, we conducted a regression with only the Attachment to Practice as the sole predictor, and we found that the proportion of variance in Total Cost that is explained is .0486. We then conducted a multiple regression analysis with Attachment to Practice plus the other nine GP and Patient variables, and we found that the proportion of variance in Total Cost explained by these ten variables increased to .0561. This increase of .0075 was obtained with the nine additional predictors and is also much smaller than the proportion explained by Attachment to Practice alone, so we conclude that Attachment to Practice is the strongest contributor to the Total Cost (among the set of variables chosen).

A second method of using multiple regression analyses looks at the incremental proportion of variability in Total Cost that each additional variable can explain as it is added to the prediction model; this type of multiple regression analysis is called hierarchical (or sequential or stepwise). There are two main ways of deciding on the order in which to add in the variables: the statistical way (the variable with the highest correlation with the criterion is put in first, followed by the variable with the next highest correlation, and so on) or the researcher can simply choose the order. In our case, the choice was easy as both approaches produced the same result: Attachment to Practice is the variable that we want entered first. It has the highest correlation with Total Cost (r=-.2208) – the next highest correlation with Total Cost is Patient Age (r=.0440). This type of multiple regression analysis gave us the same results as we have seen before: the proportion of variance that Attachment to Practice explains is .0488 when it enters the model at the first step. Patient Age enters the model in the second step (based on the statistical criterion), with an incremental proportion of variance of .0057 that it can explain in the Total Cost variable. The third variable entered is GP sex. It explains of .0005 of the variance, and the remaining variables explain progressively less. The final model, with all ten variables (each variable's contribution is statistically significant), explains the full .0561 proportion of the Total Cost variance. As before, we see in this analysis that Attachment to Practice is by far the strongest predictor of Total Cost.

In summary, taken together, the results of these analyses tend to confirm the proposition that Attachment to Practice is a real and strong predictor of total health care costs.