Physician Supply and Demand in New Brunswick[1]

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Abstract

Canada has one of the most efficient health care systems in the world. However, due to a variety of reasons, the system is experiencing significant imbalances of health care demand and supply. In order to ensure resource efficiency, improve health care accessibility, and reduce health inequities, it is imperative to address the gap between demand and supply.

In New Brunswick where the population is largely rural and rapidly aging, maintaining adequate and equitable physician services is especially challenging. The objective of this paper is to analyse physician supply and demand in New Brunswick using two databases. In particular, we present measures of physician supply and discuss factors determining the effective supply of physician services; we examine the regional variation as well as trends in the effective supply of physicians in New Brunswick. On the demand side, we present trends in the age structure of the New Brunswick population and age-sex distribution of Medicare expenditure from 1998/99 to 2001/02. The analysis serves as a starting point for projecting future requirements for physician supply and demand in New Brunswick.

I. INTRODUCTION

The primary objective of the Canadian health care system is to protect, promote and restore the physical and mental well being of residents of Canada and to facilitate reasonable access to health services without financial or other barriers (Canada Health Act). However, Canadians have many reasons to be concerned about health care – long waiting lists, crowded emergency rooms, and decreased accessibility to certain diagnostic services resulting from increasing demand and shrinking physician resources. Indeed, Canada is facing serious physician resource problems. In contrast to the 27 percent of population growth from 1980 to 2000, enrolment in

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Canadian faculties of medicine has decreased by 7 percent (CMA, 2003). According to the projected further growth in the population, unless more people are attracted to medicine, there will not be enough physicians available in the future.

New Brunswick is one of two provinces in Canada without a medical school. Representing approximately 3% of all Canadian residents receiving offers for admission to Canadian medical programs, acceptance rate for New Brunswick students in medical education programs across Canada has remained relatively consistent since 1993-1994 (New Brunswick Department of Health and Wellness, 2003). The province of New Brunswick also has various funding arrangements with a few medical schools in Atlantic Canada and Quebec for education of New Brunswick medical students. However, data from the Canadian Post-M.D. Education Registry (CAPER) indicates that only about one-third of the funded New Brunswick medical graduates are still working in the province two years after graduation (New Brunswick Department of Health and Wellness, 2003).

The objective of this paper is to analyse physician demand and supply in New Brunswick using Medicare expenditure and physician billing data. In particular, we present two measures of physician supply; examine the regional variation as well as trends in the effective supply of physicians; and conduct regression analysis of physician supply in New Brunswick. On the demand side, we present trends in the age structure of the New Brunswick population and age-sex distribution of Medicare expenditure from 1998/99 to 2001/02. The paper is organized as follows: Section II discusses the factors underlying physician demand and supply; Section III presents data analysis of physician supply; Section IV contains demand analysis; and Section V concludes the paper.

II. Factors Affecting Physician Demand and Supply

Over the past few decades, advances in science and medicine have largely reduced mortality and increased life expectancy. This has led to a significant population growth. Between 1980 and 2000, Canada's population grew by 27 percent. Recent projections also show that the nation's population will grow another14 percent by 2026, resulting in an additional 4.6 million people who will require health care (Statistics Canada).

Although the population growth rate in New Brunswick is considerably lower than the national rate (4% vs. 27%, 1980-2000), New Brunswick has a higher proportion of elderly population. According to the 2001 Census conducted by Statistics Canada, New Brunswick had one of the oldest populations among the provinces. Between 1991 and 2001, the median age of New Brunswick's population grew 5.4 years from 33.2 to 38.6, just below Nova Scotia and Quebec of 38.8, and much higher than the national level of 37.6. The census also showed significant declines in the province's population of young people as well as increases in its elderly population during the past decade (Statistics Canada). In addition, during the next few decades, New Brunswick's population is expected to remain roughly stable

but experience dramatic shift in the age structure. The proportion of the population aged 65 and over will increase from 13% in 2003, to 18% in 2015, and 25% in 2025 (New Brunswick Department of Health and Wellness, 2003).

The changing age distribution of the Canadian population is believed to be one of the largest single factors associated with the increase in the demand for health care services and hospital resources (Angus, 1985). Elderly people have a higher incidence of chronic conditions. Many also have multiple long-term health conditions and require more regular care. Compared to other age groups, they have been reported to consume more health care services and contribute disproportionately to health care spending. For example, in fiscal year 2000/2001, 13 percent elderly people (65 and over) shared 43 percent of the total health care expenditures in Canada (Health Canada).

Improvements in medical technology have continuously increased the range of treatments possible. New effective machines and technologies allow us to treat conditions that were incurable before. Many diseases like asthma and kidney failure are now manageable for patients, which is also increasing the number of chronic patients who need long-term care. This creates demand for long-term health labor inputs as well as the urgent demand for health workers who can manage the new developed technology.

Moreover, for many people, their demand for health care services is determined not only by their health status, but also by how they expect what their health status to be. Improved life quality and universal access have led to an increase in people's expectations of health care, so as to changed behaviors and beliefs about health care. Canadians' desire for access to health care increased steadily as medical diagnosis and treatment became steadily more effective and costly. Health care has become constantly more important in everyday life (Bliss, 2002).

Yet there is another source of demand pressure -- supplier-induced-demand (SID). According to Rice (1983), SID exists when a physician provides or recommends the provision of medical services that differ from what the patient would choose if he or she had available the same information and knowledge as the physician.
In Canada, fee-for-service (FFS) has been the most common physician payment method ever since the introduction of Medicare. In 2002, FFS represents 90% of total payments for clinical physicians services (CIHI). Under FFS, physicians are paid in accordance with the number of services provided, regardless of the expected effect of providing that service on the patients' health status. This type of payment creates an incentive for physicians to generate additional service to enhance income (Xu, 2003).

A higher service volume under FFS compared to alternative payment methods has been well documented. For example, Ferrall et al. (1998) use Canadian data and find that physicians working under FFS provide six more patient contacts hours per

week than do physicians working under other remuneration systems. In another study trying to distinguish physicians' desired supply from actual use, Hickson et al. (1987) find that paediatricians under FFS scheduled 4.9 visits per patient per year, while their colleagues who were paid by salary averaged 3.8 visits per patient per year.

On the supply side, due to reasons such as better living condition and more funding availability, physicians are prone to practice in urban settings, which creates barriers to care for those who live in rural and remote areas. Much evidence has indicated that rural places are much more underserved compared with urban areas at both national and regional levels. New Brunswick has a higher proportion of rural population than the rest of the country (51% vs. 22%). The recruitment and retention of physicians to rural communities in New Brunswick has been an ongoing challenge. In 2002, the rural population/GP ratio in New Brunswick is 1382, considerable higher than the Canada average of 1201 (Society of Rural Physicians of Canada).

Moreover, there has been a steady increase in the proportion of female physicians during the past few decades in Canada. The percentage of female physicians to total physicians in Canada has increased from 29% in 1998 to 32% in 2003 (Canadian Medical Association). According to the Canadian Medical Forum Task Force on Physician Supply in Canada (1999), by the year 2015 women will comprise more than 40% of the physician workforce in Canada. In New Brunswick, 37% of GPs and 21% of SPs are females. Female physicians also represent a higher proportion of the younger age groups and a lower proportion of the older age groups compared with their male counterparts. Further, with a steady increasing percentage of female medical school graduates coming into the workforce, the proportion of female physicians in New Brunswick is predicted to continue to grow in the following ten years. By the year 2013, about 48% of GPs and 39% of SPs are expected to be female (New Brunswick Department of Health and Wellness, 2003). Female physicians have been proved to be more patient orientated (Henderson et al. 2001, Roter et al. 1991). But they are also known to have a stronger preference for urban practice, stable schedules, and less working hours (CMA 2001, Ellsbury et al. 1987), which will place more pressure on physician supply.

Finally, according to the Canadian Medical Forum Task Force on Physician Supply in Canada (1999), the retirements of Canadian physicians will accelerate over the next 10 to 15 years. In New Brunswick, 18% of GPs and 29% of SPs are over the age of 55. By the year 2013, although the percentage of SPs aged 55 years and over will remain approximately the same (28%), the percentage of GPs aged 55 years and over is expected to increase to 29% (New Brunswick Department of Health and Wellness, 2003).

In summary, demand for physician services has been increasing due to population aging, increased health knowledge, improved technology, and rising expectations in health care. However, physician supply has been declining due to

retirement and aging of the physician population, increased number of female physicians and changes in physician practice and life style. The next two sections provide an overall picture of physician supply and demand in New Brunswick using the New Brunswick Medicare Program database (NBMP) and the New Brunswick Prescription Drug Program (NBPDP) database from 1998/99 to 2001/02. The MBMP database contains physicians billing data and the NBPDP database includes specific information on each prescription dispensed, on a claim-by-claim basis.

III. NB PHYSICIAN SUPPLY

In Canada, physician supply has been traditionally measured by simple counts of available physicians or physician/population ratios. These methods are straightforward and can provide useful information for cost evaluation as well as physician resource planning and management. However, the use of simple counts of available physicians assumes that all physicians are equal in terms of the provision of patient care. Physicians' output is determined by a variety of factors such as physician's gender, age, specialty, area of practice, etc. For example, some physicians are semi-retired and are only serving as part-time providers; some female physicians work flexible hours due to their family responsibilities; some physicians devote considerable time into research or teaching and therefore are relatively less active in clinical practices.

In order to develop a more meaningful measurement of physician supply, taking account of the factors affecting physician output, the practice of counting full-time physicians has been applied. Early methods of defining full time physicians have used fixed dollar amount as income thresholds. Any physician whose income met or exceeded this amount was counted as a full-time physician and others are excluded from the count. Although a later improvement has been made to include physicians whose income was below the threshold as a fraction of one full-time physician, this method has a number of methodological limitations. First of all, depending on the choice of income threshold, significantly varied results can be generated from the same set of data. Furthermore, comparability across jurisdictions, specialties, and time series are weak since these variations cannot be taken into account by fixed dollar thresholds. Later methods used percentile levels of physician income instead of fixed dollar amounts, which largely increased the jurisdictional, inter-specialty and time comparisons.

A new measure of physician supply – full-time equivalence (FTE) was first developed in 1984 by National Health and Welfare, aimed at providing a consistent basis for measuring physician supply across jurisdictions, across specialties and over time. FTE is used to estimate whether a physician is working full-time versus part-time (CIHI, 2003). It attempts to standardize physician practice volume to a common base and quantifies each physician's practice relative to what is considered a full-time workload. For those who work at a level equal to the standard will have an FTE value equal to one; for those who work at a more active level will have an

FTE value greater than one; while for those whose practice volume is below the standard will have an FTE value less than one.

Among the few measures that can be used to evaluate physician supply - number of physicians, physician work hours, volume of service provided, and physician payments – physician payments is considered to be the most appropriate measure of physician output. As mentioned above, count of physicians and hours of work does not take into account individual variations. Service volume is a reasonable measure of physician workload but is not weighted by fees or value. In this sense, physician payment is a more preferable measure since it is the product of fees and services provided.

Given the wide range of physician output and therefore physician incomes, a single cut-off benchmark does not generate appropriate results. It is more preferable to apply a range of payment values that is realistic for a typical full-time physician to determine the FTE. The National Health and Welfare methodology defines the 40^{th} to 60^{th} percentiles of payment distributions as the benchmarks. Any physician whose income falls at or in between the 40^{th} and 60^{th} percentiles is considered one FTE; any physician whose income is lower than the 40^{th} percentile accounts only a fraction of one FTE, ranging from 0 to 1; any physician whose income is higher than the 60^{th} percentile is counted as more than one FTE.

According to the methodology developed by National Health and Welfare, and also considering the data availability of the New Brunswick Medicare database, we calculate the FTE by using the following steps.

a. Select from the Medicare database all the physicians who report at least one claim in each of the four quarters of the year. This is to provide an average annual physician income level which is mostly close to reality. The determination of the benchmarks is sensitive to the distribution of physician supply. To include physicians who work only part of the year will largely lower the value of the benchmarks and ultimately result in higher supply count.
b. Create for each region and each specialty (GP/SP) a dataset within in which to calculate total billing in the fiscal year for each physician.
c. Within each region and specialty, sort physicians' total billing data from the lowest to the highest and establish the distribution of physicians by payment levels.
d. Label the payment value corresponding to the 40^{th} percentile rank as the lower benchmark and that of the 60^{th} as the upper benchmark.
e. For physicians whose income is within or equal to the benchmarks, count as 1 FTE:

$$FTE = 1$$

f. For physicians whose income is below the lower (40^{th}) benchmark, count as a fraction of 1 FTE. The fraction is equal to the ratio of his/her income to the lower benchmark:

$$FTE = total\ billing / 40^{th}\ percentile\ value$$

g. For physicians whose income is above the upper (60^{th}) benchmark, count as more than 1 FTE. A log-linear relationship is adopted to prevent high income physicians from having very large FTEs:

h.

$$FTE = 1 + natural\ log\ (\ total\ billing / 60^{th}\ percentile\ value)$$

There are a number of limitations associated with this method. First, income data used to calculate physician FTE refers to physician's payments for fee-for-service claims only. Physicians' alternative payment sources such as salary or sessional payments are not included. Second, all measures of FTE are to some extent arbitrary, since there is no "best" measure of physician workload that can be derived through statistical techniques (CIHI, 2003). Physician payment can only be used as a proxy to evaluate physicians' activity level. Third, the results of physician FTE will to some degree depend on the choice of the income benchmarks. There are no perfect adjustments to the benchmarks which can capture all the regional variations as well as changes over time.

The New Brunswick Medicare Program database (NBMP) and the New Brunswick Prescription Drug Program (NBPDP) database accounted for every claim of medical service by general practitioners (GPs) and specialists (SPs) in New Brunswick from 1998/99 to 2001/02. For each year, we calculated the following ratios: 1) ratios of GPs and SPs to population, 2) ratios of GP FTE and SP FTE to population, 3) activity ratios (the sum of FTE divided by number of GPs and SPs). To further understand the effect of age, gender, setting of practice, service area, and time series on physician supply in New Brunswick, we run regressions on physician FTE against these factors for both GPs and SPs.

Physician/population ratio

Between 1998/99 and 2001/02, the number of GPs in New Brunswick increased from 567 to 605, and the number of SPs increased from 510 to 544, both with an increasing rate of 7%. At the same time, the size of the population remained essentially constant at approximately 750,000 people. The GP/population ratio (,000 population) is, therefore, also 7% for the province and varies among health regions. As shown in Table 1, over the four-year period, the GP/population ratio increased in all but region 7, which decreased from 0.75 to 0.68 (decrease of 9%). Region 1 had the highest rate of increase (11%), followed by region 5 (8%).

For specialists, Table 2 shows that the SP/population ratio also increased about 7% for the province, with significant variations among different health regions. Region 1, again, had the highest rate of increase, followed by regions 3, 5 and 2. Regions 4, 6 and 7, on the other hand, experienced various decreasing rates of SP/population ratio (ranging from 3% to 8%).

Table 1 GP/,000 Population by Health Region, NB, 1998/99 - 2001/02

	98/99	99/00	00/01	01/02	Change
NB	0.76	0.78	0.78	0.81	6.6%
Region 1	0.76	0.79	0.79	0.84	10.5%
Region 2	0.68	0.67	0.66	0.71	4.4%
Region 3	0.76	0.81	0.73	0.80	5.3%
Region 4	0.88	0.89	0.85	0.90	2.3%
Region 5	0.84	0.95	0.93	0.91	8.3%
Region 6	0.73	0.72	0.79	0.77	5.5%
Region 7	0.75	0.75	0.75	0.68	-9.3%

Table 2 SP/,000 Population by Health Region, NB, 1998/99 - 2001/02

	98/99	99/00	00/01	01/02	Change
NB	0.68	0.71	0.69	0.73	6.8%
Region 1	0.80	0.86	0.86	0.88	9.8%
Region 2	0.75	0.80	0.79	0.80	7.1%
Region 3	0.60	0.65	0.57	0.66	9.7%
Region 4	0.64	0.65	0.59	0.60	-6.6%
Region 5	0.69	0.60	0.58	0.75	8.8%
Region 6	0.51	0.48	0.46	0.47	-8.2%
Region 7	0.46	0.42	0.47	0.45	-3.0%

Physician FTE/population ratio

As mentioned above, the use of physician/population ratio as a measure of physician supply assumes each physician has equal workload and therefore is not appropriate. Physician FTE/population ratio is preferable in the sense that it counts physicians based on their workload. Using the methodology explained above, we derived physician FTEs from the NBMP database for both GPs and SPs. When we use FTE/population ratio instead of physician/population ratio, the physician supply in New Brunswick tells a different story.

Although the GP/population ratio in New Brunswick increased about 7% from 1998/99 to 2001/02, Table 3 shows that GP FTE/population increased by less than 2%. Region 7, again, is the only region with a decreased ratio.

Table 3 GP FTE/,000 population ratio by region, NB, 1998/99 - 2001/02

	98/99	99/00	00/01	01/02	Change
NB	0.63	0.64	0.65	0.67	1.7%
Region 1	0.60	0.61	0.64	0.67	2.6%
Region 2	0.59	0.58	0.62	0.62	1.0%
Region 3	0.66	0.66	0.67	0.69	1.2%
Region 4	0.78	0.71	0.73	0.73	0.5%
Region 5	0.70	0.76	0.82	0.88	2.0%
Region 6	0.55	0.64	0.64	0.62	1.6%
Region 7	0.66	0.68	0.63	0.60	-2.4%

For SP/population ratio, Table 4 shows that compared to a 7% increase in SP/population ratio, the SP FTE/ratio decreased 5% during the four-year period. Different health regions show significantly different patterns in terms of the variation of SP FTE/population ratio over time, ranging from the lowest, a 32.5% decrease (region 5, which had one of the highest increase in SP/population ratio),

Table 4 SP FTE/,000 population ratio by region, NB, 1998/99 - 2001/02

	98/99	99/00	00/01	01/02	Change
NB	0.53	0.51	0.51	0.50	-5.2%
Region 1	0.60	0.60	0.60	0.61	1.9%
Region 2	0.60	0.58	0.59	0.55	-8.9%
Region 3	0.48	0.46	0.45	0.42	-13.0%
Region 4	0.45	0.45	0.47	0.45	0.9%
Region 5	0.52	0.47	0.41	0.35	-32.5%
Region 6	0.40	0.39	0.38	0.36	-11.1%
Region 7	0.35	0.35	0.34	0.41	19.7%

to the highest, a 19.7% increase (region 7, which had decreased SP/population ratio). Over the four-year period, the SP activity ratio decreased from 77% to 69%. The decrease of the SP activity ratio is observed in most health regions, especially in region 5, whose SP activity ratio dropped over 60% (from 76% to 47%). This explains the great reduction in its SP FTE/population ratio regardless of the increased physician/population ratio.

Physician activity ratio

The great difference between the SP/population ratio and the SP FTE/population ratio in region 5 and region 7 gives a good example of why using the physician/population ratio to measure physician supply is not appropriate. Even when the physician/population ratio increases, the actual physician supply could decrease if physicians' activity level (workload) has been reduced. We apply the physician activity ratio as another measure of physician supply. The physician activity ratio is calculated as the sum of physician FTEs divided by the number of physicians.

Table 5 GP activity ratio by region, NB, 1998/99 - 2001/02

		R1	R2	R3	R4	R5	R6	R7	NB
98/99	GP counts	139	126	126	48	27	64	37	567
	GP FTE	110.43	105.06	108.85	42.32	22.44	48.72	32.58	470.4
	Activity ratio	79%	83%	86%	88%	83%	76%	88%	83%
99/00	GP counts	147	124	135	48	30	63	37	584
	GP FTE	113.5	102.98	109.97	38.22	23.99	55.49	33.48	477.63
	Activity ratio	77%	83%	81%	80%	80%	88%	90%	82%
00/01	GP counts	148	123	132	46	29	68	37	583
	GP FTE	119.81	108.58	111.89	39.41	25.71	54.97	30.86	491.23
	Activity ratio	81%	88%	85%	86%	89%	81%	83%	84%
01/02	GP counts	157	134	139	48	28	66	33	605
	GP FTE	126.12	109.66	115.72	39.14	26.92	52.81	29.13	499.5
	Activity ratio	80%	82%	83%	82%	96%	80%	88%	83%

Table 6 SP activity ratio by region, NB, 1998/99 - 2001/02

		R1	R2	R3	R4	R5	R6	R7	NB
98/99	SP counts	148	138	99	35	22	45	23	510
	SP FTE	109.62	111.14	80.32	24.51	16.77	35.45	17.1	394.91
	Activity ratio	74%	81%	81%	70%	76%	79%	74%	77%
99/00	SP counts	159	148	108	35	19	42	21	532
	SP FTE	110.92	107.4	76.05	24.46	14.83	33.81	17.5	384.97
	Activity ratio	70%	73%	70%	70%	78%	81%	83%	72%
00/01	SP counts	160	147	96	32	18	40	23	516
	SP FTE	110.92	109.63	75.04	25.24	12.69	32.35	16.69	382.56
	Activity ratio	69%	75%	78%	79%	71%	81%	73%	74%
01/02	SP counts	166	151	110	32	23	40	22	544
	SP FTE	114.06	103.43	70.78	24.2	10.88	30.5	20.2	374.05
	Activity ratio	69%	68%	64%	76%	47%	76%	92%	69%

As shown in Tables 5 and 6, the GP activity ratio is generally higher than the SP activity ratio. Moreover, the GP activity ratio is also relatively more even across the province and more stable over time compared to the SP activity ratio. In the fiscal year 2001/02, the GP activity ratio in New Brunswick was the same as four years ago, with slight changes between 1999/00 and 2000/01. However, during the four years, the SP activity ratio decreased from 77% to 69%. The decrease of the SP activity ratio is observed in most health regions, especially in region 5, whose SP activity ratio dropped over 60% (from 76% to 47%). This explains the great reduction in its SP FTE/population ratio regardless of the increased physician/population ratio.

Regression Results

To further understand the factors that influence physician supply, we run two separate regressions of GP FTE and SP FTE against a set of explanatory variables including: physician's age, gender, practice setting, health region, and fiscal year. Most of the explanatory variables are categorical. For example, there are seven types of practice settings (office, nursing home, emergency room, residence, in patient, intensive care unit, and other). We used office visit as the base group and generated six dummy variables. The same is done for gender (male as the base group), health region (region 1 as the base group) and fiscal year (1998/99 as the base group). Considering there might be a non-linear relationship between physician FTE and age, we used both age and quadratic form of age as explanatory variables. A total of 2,281 records are observed for GPs from 1998/99 to 2001/02. The results are summarized in Table 7 for GP FTE and Table 8 for SP FTE.

Table 7 Regression Results of GP FTE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.508	.114		-4.446	.000
	female	-.178	.018	-.190	-9.923	.000
	age	.062	.005	1.555	13.239	.000
	age squared	-.001	.000	-1.541	-13.209	.000
	Region 2	-.016	.024	-.015	-.659	.510
	Region 3	.022	.023	.021	.948	.343
	Region 4	.086	.033	.052	2.630	.009
	Region 5	.122	.041	.058	3.013	.003
	Region 6	.098	.029	.069	3.380	.001
	Region 7	.015	.036	.008	.409	.683
	Nursing home	-.513	.121	-.076	-4.234	.000
	Emergency room	-.497	.031	-.294	-16.109	.000
	Residence	-.615	.121	-.091	-5.072	.000
	lin patient	-.533	.039	-.250	-13.754	.000
	Intensive care unit	-.567	.271	-.038	-2.095	.036
	Other	-.713	.220	-.058	-3.234	.001
	1999-2000	-.014	.023	-.014	-.619	.536
	2000-2001	.016	.023	.016	.715	.475
	2001-2002	.052	.023	.051	2.301	.021

a. Dependent Variable: gpfte

Out of the eighteen explanatory variables, thirteen of them are found to be significant at the 5% level. The estimated coefficient of female is negative (-0.178), suggesting a lower output level among female physicians. The coefficient for age is positive (0.062) while that for age square is negative (-0.01), which suggests that the relationship between physician FTE and physician age is an inverted-U shaped curve. A physician would gradually increase his/her workload as he/she starts practicing and gets more experienced. This may continue up until a certain age, after which the physician starts to reduce his/her workload as he/she ages. The estimates for female, age, and age squared are all found to be significant.

In terms of health regions, region 4, 5, and 6 are found to have significantly higher levels of physician FTE compared to region 1 (the estimates of coefficients are 0.086, 0.122, and 0.098 respectively). In terms of practice settings, all estimated coefficients are negative and significant, suggesting that other things being equal, GPs in an office visit setting provide the highest service level. GPs working in the fiscal year 2001/02 also tend to have heavier workload compared to four years ago.

Table 8 Regression Results of SP FTE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.064	.177		-.360	.719
	Female	-.265	.029	-.194	-9.107	.000
	Age	.053	.007	1.214	7.430	.000
	Age squared	-.001	.000	-1.396	-8.590	.000
	Region 2	-.029	.028	-.026	-1.048	.295
	Region 3	-.031	.031	-.024	-1.013	.311
	Region 4	.001	.046	.001	.023	.981
	Region 5	-.029	.056	-.011	-.521	.602
	Region 6	.008	.041	.004	.183	.855
	Region 7	.056	.054	.023	1.042	.298
	Nursing home	-.491	.180	-.057	-2.728	.006
	Emergency room	-.319	.027	-.263	-11.796	.000
	Residence	-.302	.119	-.053	-2.544	.011
	In patient	-.250	.026	-.215	-9.608	.000
	Intensive care unit	-.294	.065	-.095	-4.494	.000
	Other	.090	.210	.009	.427	.670
	1999-2000	-.006	.029	-.005	-.213	.831
	2000-2001	-.002	.030	-.001	-.056	.955
	2001-2002	.028	.030	.024	.964	.335

a. Dependent Variable: SP FTE

The same regression was also run on SP FTE. Altogether a total of 2,021 records were observed for SPs. Among the 18 explanatory variables, 8 are found to be significant at the 5% level (female, age, age square, nursing home, emergency room, residence, in patient, and intensive care unit). Similar patterns were found in the correlations between physician FTE and age as for GPs. The coefficient for "female" has a bigger magnitude in the SP model than in the GP model, which suggests an even bigger drop in female specialists' workload. No significances were found for health regions and fiscal years.

In summary, by comparing the physician count with the FTEs we found that the physician-to-population ratio based physician count over-estimates physician supply in the province. To project future supply of physician services, the FTE measure should be used. Regression results reveal that physician's age, sex, region and practice setting all contribute to the variation in the effective physician supply in New Brunswick. Therefore, changes in gender mix of the physician population, age structure, as well as practice settings will have significant impacts on the effective physician supply.

IV. NB PHYSICIAN DEMAND

On the demand side, New Brunswick has one of the oldest populations among the provinces of Canada. As shown in Table 9, between 1991 and 2001, the median age of the province's population grew 5.4 years from 33.2 years to 38.6, just below that of Nova Scotia and Quebec (38.8), and much higher than the national median age of 37.6. In addition, while the province's population of children and young people declined, the number of elderly people increased (Statistics Canada, 2001). According to Brian Crowley of the Atlantic Institute of Market Studies, during the next three decades as the baby boomers age, the proportion of the population aged 65 and over in New Brunswick will increase from 13.6% in 2001 to 18% in 2015, and 25% in 2025. This projected change in the age structure of the New Brunswick population will generate even a bigger gap between health care demand and supply.

Table 9. Selected Age Distribution Indexes, Canada, New Brunswick, 2001

	Median Age	Age group distribution (%)			Age group ratio	
		0-19	20-64	65+	20-39:40-59	15-24:55-64
Canada	37.6	25.9	61.1	13.0	1.0	1.4
NB	38.6	24.8	61.7	13.6	0.9	1.3

Source: 2001 Census, Statistics Canada.

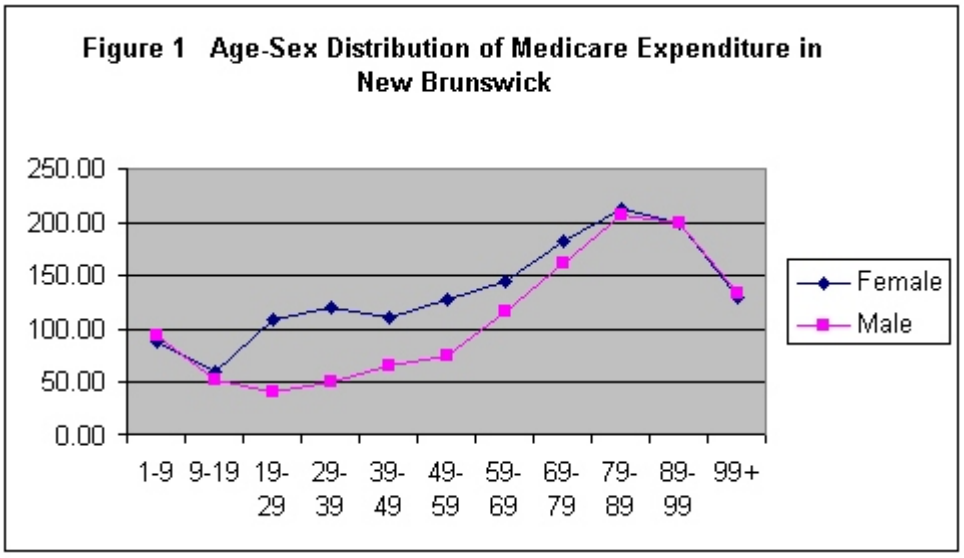
To examine health care utilization, we present in Table 10 the average expenditure by gender and health region for each fiscal year. While we understand that average expenditure does not provide a complete picture of the utilization of physician services, we use it to show differences in the utilization rate across health regions in the province. Table 10 shows that over the four-year period, the average

expenditure ranged from the lowest in Region 1 to the highest in Region 5 for both males and females.

Finally to explore the effect of age and sex on Medicare utilization, we present in Figure 1 the average expenditure by sex for ten age groups. It is well known that health care utilization changes with age. Figure 1 demonstrates the different utilization rates for different age and sex categories. This highlights the importance of the health care utilization rate by age and sex in projecting future demand for physician services. To this end, a thorough regression analysis of health care utilization taking into account factors that drive health care demand is needed. We leave this as a future task to do.

Table 10 Average GP expenditure by year / gender / health region

		Region1	Region2	Region3	Region4	Region5	Region6	Region7	NB
98/99	Females	126.87	139.12	144.08	133.91	159.72	133.57	143.03	140.04
	Males	97.91	109.29	114.97	109.19	126.46	101.16	111.24	110.03
99/00	Females	128.16	137.04	144.17	133.45	161.32	141.27	149.4	142.12
	Males	98.88	108.46	114.92	105.81	129.78	107.5	116.37	111.67
00/01	Females	130.2	137.27	145.5	133.94	165	142.54	146.4	142.98
	Males	101.62	109.75	116.55	105.88	134.82	108.64	118.51	113.68
01/02	Females	152.68	156.27	164.81	152.62	176.24	159.13	162.02	160.54
	Males	117.98	127.13	133.88	120.62	146.28	124.82	130.86	128.80



V. CONCLUSION AND POLICY DISCUSSIONS

In this paper, we have presented some preliminary data analysis on physician supply and demand in New Brunswick using two Medicare databases. We first discussed the factors affecting physician supply and demand; then turned to various supply and demand measures. The analysis shows that while there are regional differences in both physician demand and supply among the seven health regions, the province is faced with an increasing demand and relatively insufficient supply of health care service. To address these problems, we make the following broad recommendations.

Physician Resource Strategies

Physicians are the major health care providers. They play a central role in health care production. First, considerations to increase the reserved physician workforce may be proven effective. Such policy options include: increasing the number of qualified international medical graduates and immigrant practitioners accepted by the country; eliminating rules and policies on retirement; and luring expatriate Canadian physicians as well as medical students studying elsewhere to come back for practice (Xu, 2003).

Second, the federal and provincial governments can offer financial assistance to help attract and redistribute physicians to the most needed area. Such assistance can come in the form of scholarships or loan repayments, location grants, reduced set-up cost, and other financial incentives for rural practice. Physician compensation reforms, which have been recently applied across the country, present the most direct financial incentives for physicians to minimize less-necessary services and provide the optimal service volume.

Further research is needed in many fields in order to maximize the utilization of physician resources on the most needed services and at the most in-demand areas. Questions need to be answered such as: how to measure the real need for physician services; how to assess the necessity of services; and in areas where the excess demand and expanding physician expenditure are both severe problems, how to manage the tradeoff between eliminating less-necessary services and securing adequate service levels.

Nursing Resource Strategies

Due to the limit physician resources in Canada, the use of non-physician providers, especially nurses, has been extensively studied. They are found to be less costly alternatives to physicians and can improve the quality and accessibility of health care. Great interest from health researchers and policy makers has been focused on changing the scope of nursing practice as a means of increasing supply. In many jurisdictions, nurses are now offering services that are traditionally provided only by physicians.

Second, nursing resource problems can also be addressed through working condition improvements. For example, in the case of female workers who need a balance between home and work, a more flexible atmosphere can be offered, including parental leave, child-care assistance, predictable call schedules, and part-time work or job-sharing (Xu, 2003). For those who work under significant pressure, actions can be taken to prohibit mandatory overtime and to set appropriate minimum staffing levels.

A variety of issues are involved concerning expanding the boundaries of nursing practice. First, although they work with a great deal of autonomy, they are not independent practitioners. Relevant legislations and certifications are needed to define their roles, and to address issues such as the extent to which they should be permitted to practice independently as well as how intensive physician supervision should be. Second, research needs to be done to ensure optimal collaboration between physicians and nurses in order to encourage cooperation as well as to avoid dissatisfaction provoked by competition between these two professions. Finally, nursing education to guarantee that the services provided by nurses are equivalent to physician services is also a critical long-term strategy.

Alternative Health Care Deliveries

In addition to securing adequate health care human resources, it is also necessary to promote alternative options to deliver health care. In recent years, the delivery of health care services has begun to shift away from hospital inpatient treatment to many alternative settings such as outpatient services, long-term care, preventive care, home care, and community health.

As the supply of these alternative health care deliveries is increasing remarkable, some issues are becoming more controversial, such as what are the most clinically and economically appropriate financing methods for alternative deliveries; how to meet the diverse needs of care receivers with a variety of personal and contextual characteristics; how to measure the outcomes; and most importantly, how to restructure traditional practice to match the operation of varied alternative settings.

In summary, managing supply and demand is a delicate balance. Both the demand for and supply of health care services change over time with demographic, institutional, political, and educational factors. To achieve the balance, we need to explore comprehensive and effective solutions for a variety of issues. Further theoretical and empirical investigations are needed to carry out systematic analyses of the problems of organizing, financing, and distributing health services to reduce and finally eliminate the gap between health care demand and supply.

References

Angus D. Changing demands for health care: the aging phenomenon. *Hospital Trustee.* May/June1985. 22-23, 31.

Bliss M. *Canada and the health century*. National Post. 2002. http://www.aims.ca/Publications/Better/part1.htm

Canada Health Act.http://www.hc-sc.gc.ca/medicare/Canada%20Health%20Act.htm

CIHI. *Canada's health care providers*. 2001. http://secure.cihi.ca/cihiweb/dispPage.jsp?cw_page=AR_35_E

CIHI, 2003. Full-time equivalent physicians report, Canada, 2001-2002.
CMA. *Statistical information on Canadian physicians.* 2003. http://www.cma.ca/staticContent/HTML/N0/l2/statinfo/

Ellsbury K, et al. "Gender differences in practice characteristics of graduates of family medicine residencies." *Journal of Medical Education*. 1987; 62, 895.

Ferrall C, Gregory AW, Tholl WG. "Endogenous work hours and practice patterns of Canadian physicians." *Canadian Journal of Economics.* February, 1998; 1-27.

Fuchs VR. *The growing demand for medical care.* Essays in the economics of health and medical care. Columbia University Press. New York. 1972.

Henderson JT, Weisman CS. "Physician gender effects on preventive screening and counseling: An analysis of male and female patients' health care experiences." *Medical Care.* 2001; 39, 1281.

Hickson B, Altemeier A, Perrin M. "Physician reimbursement by salary and FFS: effect on physician practice behaviour in randomized prospective study." *Pediatrics.* 1987; 80, 344-350.

Legislative Office of Education Oversight. *Health care practitioners: supply and demand in Ohio. 1990.* http://www.loeo.state.oh.us/reports/PostPDF/health_prac_supply.pdf

New Brunswick Department of Health and Wellness. *Setting a new direction for planning the New Brunswick physician workforce.* Fujitsu Consulting, Final Report 2003.

Rice TH. "The impact of changing Medicare reimbursement rates on physician-induced demand." *Medical care.* 1983; 21, 803-815.

Roter D, Lipkin M Jr, Korsgaard A. “Sex differences in patients' and physicians' communication during primary care medical visits.” *Medical Care.* 1991.

Society of Rural Physicians of Canada. www.srpc.ca

Xu M. *Physician payment options in Canada*. University of New Brunswick. 2003.