LIFE CYCLE ACTIVITY PATTERNS OF PHYSICIANS

Report S:20

Division of Health Services Research
and Development
Office of the Coordinator of Health Sciences
The John F. McCreary Health Sciences Centre
The University of British Columbia
Vancouver, British Columbia
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February 1986

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R:16 *ROLLCALL UPDATE 80.* A Status Report of Selected Health Personnel in the Province of British Columbia. December, 1980

R:17 *Place of Graduation for Selected Health Occupations, 1980.* July, 1981. (B. McCashin, A. Kazanjian, M.L. Barer)

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February 1986

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February 27, 1986

Mr. D.S. Haazen
Chairman
Health Manpower Working Group
Ministry of Health
1515 Blanshard Street
Victoria, B.C.
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Dear Mr. Haazen:

It is my pleasure to transmit to you and to the members of the Health Manpower Working Group, the completed report entitled "Life Cycle Activity Patterns of Physicians".

This report reviews some theoretical and empirical literature relevant to life cycle activity patterns among physicians. It also provides a discussion of the data currently available in British Columbia on the life cycle activity patterns of physicians in this province, as well as presents some preliminary analysis based on a random sample of general practitioners practising in B.C.

I trust the information contained here will be helpful to the Ministry in its policy and planning activities. We would welcome any comments you may have on this particular study.

Yours sincerely,

Morris Barer per AK

Morris L. Barer, Ph.D.
Associate Director
Division of Health Services
Research and Development

MLB:kc

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The challenges involved in the forecasting of physician manpower requirements have been well documented (Todd, 1983; Katz, et al., 1977; Ginzberg, 1983; Schroeder, 1984, Moore, 1982). The numerous factors believed to be involved in estimating requirements and supply of physicians have also been outlined quite extensively in previous reports. Briefly, these factors include number of physicians graduating from medical schools within Canada, number of physicians emigrating from Canada, number of foreign trained physicians entering Canada each year, the health care needs of the population, economic conditions, and changing patterns of health care delivery.

Most Canadian studies aimed at the forecasting of net physician requirements have incorporated at least these factors into their methodological frameworks (Ontario Council of Health, 1983; Canada, 1975; Canada, 1985; Roos, 1983). Only recently, however, has attention begun to be focused on the influence of potential variation in activity levels during a medical practice career on estimates of future physician requirements. For example, female physicians may remove themselves periodically and temporarily from the work force in their late twenties and thirties to attend to child-bearing and child-rearing responsibilities, and physicians may retire at different ages. These and other factors may significantly alter the average length of a physician's working life. Most projection studies have assumed some fixed work life, and only recently have studies begun to focus on the potential effects of a growing proportion of female physicians (Ontario Council of Health, 1983; Canada, 1985).

The Health Manpower Research Unit at the University of B.C. has been involved for a number of years in various aspects of methodologic development related to the forecasting of physician supply and requirements (e.g. Barer and Wong Fung, 1982; Barer, Wong Fung and Hsu, 1983; Barer and Wong Fung, 1985). The present paper represents a first report from a project aimed at examining the determinants of and evidence on physician life cycle activity patterns.

This paper contains four sections. In the first, we review some theoretical and empirical literature germane to life cycle activity patterns among physicians. Section II discusses the data currently available in B.C. to support empirical investigations of those patterns. In section III we report some preliminary results based on a random sample of general practitioners. The final section of the paper outlines briefly the next stages in the project.

I. DETERMINANTS OF LIFE CYCLE ACTIVITY PATTERNS

Among all the variables thought to influence activity patterns, age and sex have emerged as the most important. Although an abundance of other influences appear to exist (i.e. family composition, income aspirations, practice location and style, attitudes towards retirement), many of them are confounded with one another and with age and sex. We restrict our discussion, therefore, to past findings relating to the roles of age and sex only.

<u>Age</u>

The age of a physician is by far the most clearcut determinant of activity levels. There is no activity prior to graduation and no activity after retirement or death (whichever comes first). The pattern between the end points is less clear but the few studies that are available on age and activity levels do suggest a concave quadratic relationship of some form whereby activity levels are low in the formative years of a practice, increase relatively rapidly to a plateau and then begin to decline slowly when physicians reach their late 50's.

Woodward and Adams (1985) analyzed data on 38,653 Canadian physicians. The data were obtained from the physician resource databank which has been compiled and is maintained by the Canadian Medical Association. The 38,653 physicians used in the analysis did not include some 2,946 physicians who indicated that they were engaged in postgraduate training at the time. For British Columbia, information on 5,427 physicians was obtained. It was found that 19.8 percent of the B.C. physicians were less than 35 years of age, 28.3 percent were between 35 and 44 years of age, 20.3 percent were between 45 and 54 years of age and 9.9 percent were between 55 and 59 years of age (see Table 1). Interestingly, while 8 percent were between 60 and 64 years of age, a total of 688 physicians, or 13.7 percent, were 65 years of age and over.

Woodward and Adams observed a difference in activity level (estimated by taking into consideration the self-reported hours per week and weeks per year worked) among the various age groups, with peak activity among the

*Table 1: PHYSICIANS IN CANADA AND IN B.C. BY AGE, NOVEMBER 1982

Age Category	British Columbia N	British Columbia %	Canada N	Canada %
<35	1076	(19.8)	8991	(23.3)
35-44	1535	(28.3)	10323	(26.7)
45-54	1101	(20.3)	8059	(20.9)
55-59	539	(9.9)	3671	(9.5)
60-64	434	(8.0)	2782	(7.2)
65-69	308	(5.7)	1863	(4.8)
70-74	192	(3.5)	1098	(2.8)
75>	188	(3.5)	1269	(3.3)
No birthdate given	54	(1.0)	597	(1.5)
All ages	5427	(100.0)	38653	(100.0)

* Adapted from: Woodward and Adams (1985)

35-44 year old physicians. Results showed that on a national basis, 93.9 percent of the 35-44 year old physicians worked full-time (Table 2). The percentages working full-time for the less than 35, 45-54, 55-59, 60-64 and 65+ year age groups were 89.9%, 94.2%, 90.2%, 79.3% and 29.1% respectively. Seven percent of physicians less than 35 years of age worked part-time. This reduced to 3.9%, 2.9% and 3.7% for physicians falling into the 35-44, 45-54 and 55-59 year age groups respectively. Interestingly, 19.4% of physicians between the ages of 65 and 69 were semi-retired compared to 24.3% and 16.2% for physicians between 70-74 and 75+ years of age respectively. With regard to physicians who had fully retired, the percentages were 22.5%, 38.3% and 62.0% for the 65-69, 70-74 and 75+

*Table 2: PHYSICIANS' LEVEL OF ACTIVITY BY AGE, CANADA, NOVEMBER 1982

Level of Activity	AGE CATEGORY								No Birth Date	Total
	<35 (%)**	35-44 (%)	45-54 (%)	54-59 (%)	60-64 (%)	65-69 (%)	70-74 (%)	75> (%)		
Full-time	8,086 (89.9)	9,693 (93.9)	7,592 (94.2)	3,312 (90.2)	2,206 (79.3)	847 (45.5)	262 (23.9)	124 (9.8)	373 (62.5)	32,495 (84.1)
Part-time	632 (7.0)	405 (3.9)	232 (2.9)	136 (3.7)	140 (5.0)	154 (8.3)	100 (9.1)	82 (6.5)	21 (3.5)	1,902 (4.9)
Semi-retired	6 (0.1)	13 (0.1)	21 (0.3)	57 (1.6)	163 (5.9)	362 (19.4)	267 (24.3)	206 (16.2)	12 (2.0)	1,107 (2.9)
Retired	5 (0.1)	19 (0.2)	28 (0.3)	69 (1.9)	156 (5.6)	419 (22.5)	421 (38.3)	787 (62.0)	114 (19.1)	2,018 (5.2)
Other	181 (2.0)	108 (1.1)	99 (1.2)	37 (1.0)	65 (2.3)	34 (1.8)	16 (1.5)	17 (1.3)	38 (6.4)	595 (1.5)
Not Reported	81 (0.9)	85 (0.8)	87 (1.1)	60 (1.6)	52 (1.9)	47 (2.5)	32 (2.9)	53 (4.2)	39 (6.5)	536 (1.4)
Total	8,991 (100.0)	10,323 (100.0)	8,059 (100.0)	3,671 (100.0)	2,782 (100.0)	1,863 (100.0)	1,098 (100.0)	1,269 (100.0)	597 (100.0)	38,653 (100.0)

* Adapted From: Woodward and Adams (1985)

** FIGURES IN PARENTHESES ARE COLUMN PERCENTAGES year age groups respectively. Finally variations across selected specialties in activity levels with regard to age were observed (see Table 3). The bulk of physicians working full-time were more or less evenly distributed between the 35 to 44 and 45 to 54 age groups for the specialties of Obstetrics/Gynecology, Psychiatry, Radiology and Surgery. Exceptions came from physicians working full-time in general/family practice (where 38% were less than 35 years of age and 29% were between 35 and 44 years of age) and Internal Medicine and Paediatrics where the largest groups of full-time workers were between the ages of 35 and 44.

* TABLE 3: PERCENTAGE OF PHYSICIANS PRACTISING FULL-TIME BY AGE AND SPECIALTY, CANADA, NOVEMBER 1982

SPECIALTY	AGE CATEGORY						No Birthdate Given
	<35	35-44	45-54	55-59	60-64	65>	
Anesthesia	13	26	33	14	9	4	1
General/Family Practice	38	29	17	8	5	3	1
Internal Medicine	25	37	19	9	6	4	1
Obstetrics/ Gynecology	12	30	31	13	10	5	1
Pediatrics	18	35	25	10	7	3	2
Psychiatry	14	32	32	12	6	3	1
Radiology	13	32	30	14	8	3	1
Surgery	10	30	31	14	8	6	1

* Originally published in Canadian Medical Association Journal, Vol. 132, May 15, 1985

In an American survey conducted by the National Center for Health Statistics it was found that out of 779 general practitioners and family physicians, the 45 to 54 year old age group saw the most patients each week. The age groups under 35 and over 65 saw the fewest patients (Medical World News, 1984). It was also reported that the under-35 physicians see relatively more patients under 25 years of age as a proportion of their total practices: the relationship reported was that patient age tends to increase with physician age. The younger physicians also provided more non-illness care, prescribed fewer drugs and were less likely to be in a solo practice.

Much of the work on age and activity levels ties in with the literature on retirement patterns among physicians. An assumption that all physicians retire at 65, if, in fact, they all do so at 60 or 70, may have a sharp impact on future supply projections and derivative policies.

Willingness to retire appears to be lowest among those physicians who are both deeply involved in their work and have remained in practice six or seven years beyond the average retirement age of 65 (Macgregor, 1983; Gaitz, 1977; Grauer and Campbell, 1983). In a survey of Canadian physicians by Grauer and Campbell (1983), it was found that 93% of the physicians over the age of 65 were still working, with 78% of these working physicians involved only in direct patient care. Of the four physicians who were retired, two had retired for health reasons. Sixty-five percent of those working physicians over the age of 65 years indicated that they were working 40 or more hours per week; 11% were working 10 hours or less per week. Half of the physicians in the sample had postponed retirement for financial reasons. Macgregor (1983) suggested that since physicians are highly motivated and disciplined professionals, they very likely will not change their practice patterns just because of their age.

Currently, there appears to exist a great deal of resistance on the part of many physicians to a mandatory retirement age of 65. Given that retirement has generally become associated with inadequacy and peer review, it is understandable that so many physicians are reluctant to be forced into retirement. Arguments against a compulsory retirement age include loss of income to physicians, loss of skilled manpower to the profession and adverse effects on the mental and physical health of retiring physicians (Gillies and Ross, 1984; Gaitz, 1977). In Grauer and Campbell's survey (1983), sixty percent of the physicians questioned felt that there should not be a compulsory retirement age. However, 57 percent of the physicians thought that peer evaluation should be required for those physicians wishing to continue working after the age of 70; another 32 percent felt that the mandatory retirement age should be shifted to 70 years. On the other side, arguments could be forwarded that in the face of a continuing expansion in the supply of physicians, and in the absence of policies targeted at the other end of the life cycle, mandatory retirement might ease some of the medical care cost pressures currently being felt in all provinces.

In conclusion, a standard pattern of retirement among physicians does not appear to exist. The literature to date suggests that the majority of physicians continue to practice medicine after the age of 65 and that projection studies aimed at forecasting physician requirements should take this into consideration in their methodological designs. So far, this seems not to have received attention. For example, the recent National Physician Manpower Study (Canada, 1984) assumed a working life of about 39 years for general practitioners and 35 years for specialists. Furthermore, Canadian evidence to date on activity patterns by age has been generated solely through surveys of practitioners. One of the aims of this project is to use objective data to perform the relatively simple task of finding out exactly what does happen to activity levels as physicians reach potential retirement age.

Sex

The percentage of women graduating from Canadian medical schools in 1969 was 13 percent (Guzman, 1981). By 1981, 40 percent of the first year enrollment in Canadian medical schools was female (Ryten, 1981). Therefore, by 1985, approximately 40 percent of the graduating students from Canadian medical schools would be expected to be female. The impact (if any) that this should have on forecasting medical manpower requirements remains to be studied in more detail. At the very least, and as a beginning, reliable information is required on female physicians as to their distribution among the various specialties, their average number of hours worked per week, patterns of practice and patient loads, net income levels, and the number and pattern of years they remain professionally active.

Previous studies have pointed towards differences in specialty distributions, practice modes and 'productivity' levels between male and female physicians. Since the various authors have used different definitions of productivity and activity level it becomes somewhat difficult to directly compare these studies. Generally, results appear to be quite conflicting. On the one hand, many authors suggest that female physicians work fewer hours, spend fewer years in full-time active practice and earn less compared to their male counterparts (Mitchell, 1984; Woodward and Adams, 1985; Bobula, 1980; Kehrer, 1976). Reasons given for this lower activity level have revolved around societal norms demanding professional women to take on a dual role in life -- child-rearing and household duties in addition to their highly demanding professional careers. On the other hand, there is evidence which indicates that women physicians are as active professionally as their male counterparts (Medical World News, 1984; Heins, et al., 1976; Heins, et al., 1977). Following is a review of the literature on studies investigating potential gender differences in professional activity.

In their analysis of the Canadian Medical Association survey of 41,599 Canadian licensed physicians, Woodward and Adams (1985) found that 14.2 percent of their sample were female with close to half (43.5%) of them being less than 35 years of age and 26.1 percent falling between 35 and 44 years of age (i.e. almost 70 percent of the women physicians licensed to practice medicine in Canada were less than the age of 45). An interesting finding was that the percentages of females working full-time were 74.9%, 72.7%, 76.7% and 69.6% for the <35, 35-44, 45-54 and 55-59 year age groups respectively. These percentages were consistently lower than those for male physicians (96.0%, 97.7%, 97.0% and 93.0%) in the same age groups. These findings for female physicians are contrary to opinions that females significantly reduce their level of professional activity during the child-rearing years, and resume a full-time work load following this time period. This survey indicated that the proportion of females working full-time remained relatively constant, until beginning a steady decline following 55 years of age. For male physicians, the decline in full-time activity was more marked after the age of 65. Other findings by Woodward and Adams were that women physicians, compared to their male counterparts, work fewer hours per week, retire earlier and fewer of them continue working beyond age 65; sixty-four percent of physicians in part-time general/family practice were female.

A brief newsletter published in the Medical World News indicated that, according to a Canadian Researcher, Dr. L. Curry, female physicians devote an average of 62 hours per week to professional activities compared with an average of 61 hours per week for male physicians. Of this, direct medical service consumed an average of 47.5 hours per week for males, 43.6 hours for females. Both males and females worked an average 42.3 weeks per year according to Curry. The largest difference comes about during the child-rearing years; however, female physicians were found to spend considerably more time during these years in continuing medical education courses.

According to results of a National Center for Health Statistics (1984) survey of 779 general practitioners and family physicians, female physicians see an average of 52 patients per week compared with 88 for male physicians. Furthermore, female physicians spend an average of 16.7

minutes with each patient compared with 13.4 minutes for male physicians. They also see a higher percentage of female patients and younger patients with roughly 75 percent of weekly consultations being with female patients (compared to 59 percent for male physicians) and 44 percent of the patients being less than 25 years of age (compared to 29 percent for male physicians).

Some support for the data published in the Medical World News comes from a study by Heins et al. (1976) in which 87 female physicians in metropolitan Detroit were surveyed. Eighty-four percent were working as physicians at the time of the survey. Ninety percent of those were working full-time and 59 percent had worked full-time continuously since graduation from medical school. The sample ranged in age from 30 to 86 years. Sixty-seven percent of the sample were married. Half of them indicated that they had no intention of retiring from medical work and would do so only if they became physically unable to work or keep up in their medical field. Six women from the sample were not employed for reasons related to children and marriage. With regard to activity level of the physicians who were working, 4 percent worked less than 20 hours per week; 80% of the women with children under 18 years of age worked full-time compared to 87% of the women without children. Apparently, child-rearing had a relatively minor effect on the activity level of the women in their sample. Other findings of interest were that 70 percent of the sample were self-employed (over one-third of them worked alone, 20% had a partner and 14% were in a group setting) and 54 percent were in the primary care specialties of family practice, general practice, obstetrics-gynecology, internal medicine and pediatrics.

In another study by Heins et al. (1977), the productivity of 87 female and 95 male physicians was compared. At the time of the survey, 96 percent of the men were engaged in medical work, and 87 percent of the men had worked full-time since graduation from medical school. These may be compared with the 84 percent and 59 percent noted in the earlier article for the female physicians in the sample. Significantly more women than men worked in a non-private practice setting but nearly identical numbers of both samples were in solo practice. A medical work ratio (number of years worked divided by the number of years since medical school graduation) was found to be 0.88 for the women, 0.99 for the men.

The major drawback in these two studies by Heins et al. was the small sample size used in their research, limiting the generalizability of their results. Also, since a finer breakdown of their results with respect to age, specialty and other demographic characteristics was not available, many of the percentages reported require cautious interpretation.

Kehrer (1976) analyzed factors affecting income differences between men and women physicians using data from the AMA's 1973 eighth periodic survey of physicians. The sample included 641 female and 4,297 male physicians from across the United States. The author reported an average income in 1972 of $47,953 for male physicians compared to $27,558 for female physicians. As noted by Kehrer, this income differential reflects, at least in part, the different specialty distributions of male and female respondents. Women physicians tended to be concentrated in the less remunerative specialties such as general-family practice, paediatrics and psychiatry while male physicians tended to dominate the high-income surgical specialties. Kehrer also noted that the male respondents worked an average of 51.5 hours per week compared to 41.6 hours for females.

Using a least squares regression model developed by Mincer (1970), Kehrer derived separate income equations for male and female physicians using the natural logarithm of net income per hour as the dependent variable, and physician experience, professional and practice characteristics and market characteristics as the explanatory variables. In summary, Kehrer found (not surprisingly) that one of the most important factors in lower annual incomes for women physicians is their fewer hours worked per week. Furthermore, women who were married worked significantly fewer hours, whereas there were no significant differences among male physicians. It was also found that, regardless of sex and everything else being equal, being over the age of 60 was associated with 22 percent fewer hours worked. Having a child under the age of 6 was associated with insignificantly fewer hours worked by women. Finally, women were found to take fewer than 1.5 years out of their careers in order to attend to child-rearing and other household responsibilities.

A report by the Socioeconomic Monitoring System (March 1984) in cooperation with the American Medical Association, noted that female physicians in 1983 were less likely to be self-employed, worked fewer hours and attended to fewer patients per week compared to their male counterparts. There was a 26.4% difference between the sexes in the number who were self-employed, and on average female physicians worked 7.9 percent fewer hours and saw 18.5% fewer patients per week than male physicians. It was suggested that the lower percentage of self-employed physicians among females may partly result from differences in age distribution, with a greater proportion of females being younger physicians who prefer to work as employees. On the other hand, a greater proportion of male physicians are likely to have practised medicine for a greater number of years and, consequently, be settled within their practices. Female physicians were also reported to earn less (in 1982, the average net income for male physicians was $102,000 compared to $65,200 for females). Again, it was suggested that part of this income differential could be attributed to differences between the sexes in the number of hours worked per week, to specialty and age distributions and to employment status. Support for this notion comes from the finding that the differentials are narrowed considerably when one considers net income per hour, controlling for the effect of specialty, age and employment status.

Langwell (1982) indicates that changes across time have occurred in the direction of greater equality of incomes between male and female physicians practising in the United States. Adjusting for hours worked, the hourly earning differential between male and female physicians dropped from 29 percent in 1972 to 22.1 percent in 1977. This income differential in 1977 varied across specialties from 18.8 percent for anaesthesiology to 44.7 percent for internal medicine. Langwell also observed that female physicians saw 37 percent fewer patients per hour than male physicians, a finding highly suggestive of different patterns of practice. Freiman and Marder (1984) reported changes in the hours worked by American physicians from 1970 to 1980 and reported a significant decline of 3 percent or 1.5 hours per week. However, female physicians showed a statistically insignificant increase in their average hours worked.

Results from a survey to examine differences between male and female physicians in work patterns and practice characteristics using data from AMA's twelfth periodic survey of physicians conducted in 1978 were presented by Bobula in 1980. In brief, it was found that male physicians were more likely than female physicians to work in solo, fee-for-service or group-practice settings. Female physicians were more likely to be employed in a student health centre, local government agency or corporation and more frequently to be reimbursed on a salary basis. Furthermore, male physicians worked, on average, 50.9 hours per week, 47.1 weeks per year and earned an average net income of $62,700 compared to female physicians working 43.7 hours per week, 45.9 weeks per year and earning an average net income of $43,700. According to Bobula, even if women physicians worked the same number of hours per week and weeks per year as men, the mean income for females would be 83 percent of that for males. With regard to patient characteristics, patients of female physicians were found more often to be female, non-white and younger than patients of male physicians. Across all specialties, 62.4 percent of the patients of female physicians were female compared to 59.5 percent for male physicians.

Using national data on 74,265 physicians from seven U.S. graduation cohorts (1970 to 1976), Weisman et al. (1980) reported a trend toward convergence of male and female career patterns with regard to specialty choice during graduate medical education, patterns of switching specialties and subspecialization and duration of graduate medical training.

Two remaining studies which have appeared in the literature deserve noting here. Generally, they support data from other studies pointing towards fewer hours worked by female physicians compared to their male counterparts, and they emphasize the incorporation of such information into projections of future requirements for physicians. Mitchell (1984) analyzed data on a sample of 558 female physicians and 4,510 male physicians in the United States. Findings included (1) men average three extra working hours per week relative to women, although this differential is halved once specialty differences are controlled for; (2) these differences in hours worked are most marked for women psychiatrists and obstetricians/gynecologists who average four and six hours less per week respectively than their male counterparts; (3) an exception was women general practitioners who reported working four hours per week more than their male counterparts.

In search of factors underlying these differential work patterns, Mitchell used five groups of explanatory variables in an econometric regression analysis. These were wage or hourly income, personal characteristics, household characteristics, specialty, private characteristics and area characteristics. The two dependent variables specified were hours spent in patient care activity per week and the number of weeks worked in the last year. Four separate regressions were performed for hours worked and weeks worked for male and female physicians separately. Findings were that male physicians responded positively to higher net hourly incomes but work effort reduced after a critical level of income was reached. Female physicians, however, were apparently not responsive to hourly net incomes. The relationship between hours and weeks, and age of physicians, followed a concave shaped relationship but for males only (they work longer hours in the early stages of their careers, reach a peak level around the age of 44 and then begin to reduce their work activity thereafter). Married female physicians were found to work significantly fewer hours than single female physicians; however, no such effect was found for male physicians. Also, women physicians with children were observed to work the same number of hours as those without children.

Finally, a study by Lanska, Lanska and Rimm (1984) concluded that the surplus, estimated from previous research (by the Graduate Medical Education National Advisory Committee), of 145,000 physicians in the year 2000 would be reduced by 41,000 physicians once the changing male/female ratios of physicians were taken into account. Using various procedures for estimating the sex distribution among age groups in the year 2000, Lanska et al. predicted that in the year 2000, 26.5 percent of the physicians in the United States would be female. In the final stage of their analysis, the authors assumed that female physician productivity could be stated as 60 percent of male physician productivity; on the basis of this assumption, a full-time equivalent ratio (FTE) of 0.937 was arrived at by dividing the average lifetime productivity of physicians in the year 2000 by the average lifetime productivity of physicians in the year 1982. That is, according to these authors, each physician, on the average, in the year 2000 will be

94 percent as productive as the average 1982 physician, solely because of differences in age and sex mix.

Several assumptions were made by Lanska et al. which are worth noting here. The most basic assumption underlying their research was that female physicians work 40 percent fewer hours during their lifetimes compared to their male physician counterparts. In light of the mix of evidence that has appeared in the literature to date, the validity of this assumption must be seriously questioned. Even if it is assumed that female physicians across a lifetime do work fewer hours than male physicians, a 40 percent difference seems extreme considering the evidence reviewed above. Another assumption was that sex distributions would remain constant within an age cohort as that cohort aged. For example, if 12 percent of physicians aged between 35 and 44 were female in 1980, they estimated that 12 percent of physicians in the 55-64 group would be female in the year 2000. No consideration was given to the sex mix of addition or attrition to the U.S. physician stock over this period. Finally, there remains the long outstanding question of the validity of hours of work as a proxy for capacity. If practice patterns differ, with no apparent derivative differences in patient outcomes, hours of work differentials may grossly overstate implications for future clinical capacity.

The literature which has addressed the impact of age and sex on levels and patterns of activity is synopsized in Table 4.

TABLE 4: SYNOPSIS OF LITERATURE ON THE EFFECTS OF AGE AND SEX ON PHYSICIAN ACTIVITY LEVELS

Authors/ Country	Sample Description	Age Range	Male Physicians Level of Activity				Female Physicians Level of Activity				Total Level of Activity			
			N	% Working Full-Time	# Hours Worked/Week GP/FP's	# Hours Worked/Week Specialists	N	% Working Full-Time	# Hours Worked/Week GP/FP's	# Hours Worked/Week Specialists	N	% Working Full-Time	# Hours Worked/Week GP/FP's	# Hours Worked/Week Specialists
Woodward and Adams (1985) Canada	Male Physicians:	<35	6602	95.3	54.4	57.0	2389	75.1	44.6	47.4	8991	89.9	49.3	52.2
	Specialists = 18,189	35-44	8886	97.2	55.1	56.6	1437	73.4	41.0	46.6	10323	93.9	48.1	51.6
	GP/FP's = 14,967	45-54	7281	96.2	55.4	55.7	778	75.7	43.0	46.7	8059	94.2	49.2	51.2
	Female Physicians:	55-59	3333	92.3	54.0	54.0	338	69.8	42.5	44.8	3671	90.2	48.3	49.4
	Specialists = 2,137	60-64	2579	80.1	50.2	49.3	203	59.6	38.1	45.2	2782	79.3	44.2	47.3
	GP/FP's = 3,360	65+	3958	30.0	36.5	33.1	272	17.3	37.0	28.3	4230	29.1	36.7	30.7
	Total = 38,653	Age Unknown	517	62.3	48.1	54.6	80	63.8	45.6	47.8	597	62.5	46.9	51.2
National Center for Health Statistics Survey (1984) U.S.A.	N = 779 General and Family Practitioners	<35		1) See an average of 88 patients per week 2) Spend an average of 13.4 minutes with each patient				1) See an average of 52 patients per week 2) Spend an average of 16.7 minutes with each patient				Least Active		
		45-54										Most Active		
		>65										Least Active		
Grauer & Campbell (1983) Canada		>65										65.0	40+	
Curry (1984) Canada				Work an average of 61 hours each week. Of this, direct medical service consumed an average of 47.5 hours.				Work an average of 62 hours each week. Of this, direct medical service consumed an average of 43.6 hours.						
Heins, et.al. (1976, 1977) U.S.A.	Male Physicians: GP/FP's = 17 Specialists = 78 Female Physicians:			96.6	40+ hours/week MWR* = 0.993			76.0	40+ hours/week MWR* = 0.880					
	GP/FP's = 6 Specialists = 81 Total = 182	65+		53.0	40+ hours			33.0	40+ hours					
Kehrer (1976) U.S.A.	Male Physicians = 4,297				Average = 51.5 hours/week				Average = 41.6 hours/week					
	Female Physicians = 641 Total = 4,938	60+			Worked 20% fewer hours than other age groups				Worked 20% fewer hours than other age groups					
Langwell (1982) U.S.A.							See 37% fewer patients/hour compared to male physicians							
Bobula (1980) U.S.A.					Average = 50.9 hours/week				Average = 43.9 hours/week					
Mitchell (1984) U.S.A.	Male Physicians = 4,510 Female Physicians = 558 Total = 5,068				49.1	47.0			53.1	43.3				

*MWR = Medical Work Ratio = full-time equated months in medical work since medical school graduation divided by the total months since medical school graduation

II. DATA AVAILABILITY FOR B.C. PHYSICIANS

Information on life cycle activity levels requires data on physician age, and on levels of activity. The latter can be based on hours of work (per week, per year, etc.), or on incomes or billing patterns. There are problems with each as 'windows' on levels and patterns of activity. A practitioner may work forty-five hours per week at age 35 and 65, but over the intervening thirty years may change his/her pattern of practice such that his/her activity level (intensity of servicing, productivity, or whatever) changes markedly. But equally, two practitioners each generating $200,000 in fee billings over a year may have quite different patterns of practice, one requiring 16 hour days and 49 week work-years, the other only 9 hour days and 44 weeks per year, to generate the same income.

There is no 'right' way to approach the measurement of activity levels, even within any particular specialty, because of these differing patterns of practice. For B.C. physicians, hours of work data exist in the C.M.A. data base, but are currently unavailable to independent researchers in disaggregated form. But information on age and billings by physician is available from the College of Physicians and Surgeons of B.C., and the Medical Services Plan of B.C., respectively. In addition, data on place of graduation, sex and specialty are available from the former; on type of practice and practice location from the latter.

Other determinant characteristics such as marital status or family composition, are not recorded by either body. Such data would need to be generated by special survey.

In the following section we describe some preliminary cross-section analyses undertaken on a random sample of B.C. general practitioners for the year 1983/84.

III. ACTIVITY LEVELS AMONG B.C. GENERAL PRACTITIONERS, FISCAL 1983/84

The vast majority of the literature that has investigated physician activity levels has been American. Other than the recent paper published in 1985 by Woodward and Adams (see Table 5 for an adaptation of one of their tables showing physicians in B.C. versus the rest of Canada), very limited Canadian information exists. Furthermore, irrespective of source, much of the information is survey based and hinges on self-reported hours of work information provided by samples of physicians. Even where income has been used to proxy activity levels, it has been based on physician samples, and has been cross-sectional in nature.

The eventual objective of this project is to report on the results of pooled time series/cross section regression analyses on the entire B.C. population of physicians. This will allow the circumvention of problems noted below with cross-section income data and, we believe, will represent the first physician population-based study in the area.

To explore some of the likely data problems, and to 'get our feet wet', we first analysed activity patterns for a random sample of general practitioners. In this section we report the results of that analysis; in the following section we map out a plan for extensions to these preliminary investigations.

*TABLE 5: PERCENTAGE OF GENERAL/FAMILY PHYSICIANS AND ALL PHYSICIANS BY LEVEL OF ACTIVITY STATUS, B.C. VERSUS REST OF CANADA, NOVEMBER 1982

	B.C.	CANADA (excluding B.C.)
FULL-TIME		
GP/FP's	80.2	84.1
All Physicians	78.8	84.9
PART-TIME		
GP/FP's	8.4	6.0
All Physicians	6.5	4.7
SEMI-RETIRED		
GP/FP's	2.3	2.3
All Physicians	3.4	2.8

*Adapted From: Woodward et al.

Life Cycle Model

The literature review suggested that age and sex would likely be the variables of primary interest in developing a life cycle model of activity levels of practitioners. In order to assess their role in shaping activity levels, some effort is required to attempt to standardize for other potentially confounding or important variables. These might include general economic conditions, family composition, income aspirations, practice location, practice style and the like.

Thus, a life cycle activity model might appear as follows:

ACTLEV = f (AGE, SEX, LOCATION, FAMCOMP, YTARGET, PRACSTYLE,...)

In actual fact, since this particular analysis uses a cross-section of practitioners to estimate parameters of a time series model, some of these variables become irrelevant or unavailable. For example, general economic conditions can be proxied by practice location, since changes in such conditions over time are not relevant to a cross-section analysis, but economic conditions may vary across regions at any single point in time. Information on practitioners' family composition and income aspirations was unavailable, as was information on practice style (although as an extension to this paper, an attempt will be made to integrate such information as may be obtainable from the Ministry of Health on practitioners who are participants in group practices or clinics). But one could argue that a practitioner's medical training would partially determine practice style. A variable indicating country of graduation was employed as a practice style proxy. A further indication of practice style may be the manner in which a practitioner chooses to be paid. Accordingly, the empirical estimation employs an indicator of non-fee-for-service activity.

The likely directions of effect on activity levels are as follows:

AGE ----- (+) then (-)

SEXF ----- (+) with magnified effect in maternity years

LOCATION ----- (+) in regions with lower physician/population ratios

PLACE OF GRADUATION ----- ? but a guess might be (-) for U.K. graduates, (+) for U.S. graduates, if there are any significant differences

NON-FEE-ACTIVITY ----- (-) activity level is likely to be lower among salaried and sessional practitioners than among fee-for-service practitioners because of the differential incentive structures.

Data Sources, the Data Set and Variable Construction

The dependent variable in this model is activity level. Unfortunately, as noted above, the only data for B.C. practitioners on hours of work are held in the Canadian Medical Association's data base, which as yet has not been made widely accessible to researchers. Self-reported hours of work data, particularly for a profession that has been lobbying forever for shorter work weeks and higher fees, are suspect in any event (see, for example, Ontario Council of Health (1983) which uses information solicited from Ontario physicians indicating average work loads of 2,500+ hours per year (excluding on call time)!

Data on service provision ought to provide a relatively accurate picture of practice activity. Unfortunately heterogeneity of services makes weighting necessary. In the absence of average time per service information, service prices can be argued to proxy service time. Having prices or fees as utilization weights, one ends up with fee payments as an activity level measure. Not that such a measure is without problems. There will inevitably be considerable variability across practitioners in the distribution of time spent for any given fee service. Some practitioners likely average five minutes per regional exam; others may take as long as 30 minutes. Yet each exam would be weighted equally, by the fee level for the service. In addition, some practitioners earn non-fee income which, of course, may weight services quite differently.

The original intent was to restrict attention to fee practice physicians. However, examination of the actual data set revealed a number of practitioners with no fee income but small amounts of non-fee income. Since this may represent one method of retirement, arbitrary exclusion of these posed the possibility of introducing unknown bias to the results. As an alternative, all practitioners (with the exception of those noted below) were left in the data set, and the impact of non-fee activity was built into the model through an explanatory variable.

The source for all income data was the Medical Services Plan of B.C. (MSP). Information on total fee, salary and session payments for each general practitioner receiving any payment during fiscal 1983-84, was available in computerized files maintained by the Health Manpower Research Unit at U.B.C. With the kind permission of MSP, these data were accessed to construct both the dependent variable and a number of independent variables described below.

All the other data fields were obtained from computerized files containing information received from the College of Physicians and Surgeons of B.C. Again with their permission and the usual provisos of ensuring that results do not identify individual practitioners, access was gained to practice location, age, sex and place and date of graduation for each practitioner. These two data sets were linked on the common MSP billing number field, and then a stratified random 10% sample was extracted for analysis using IDA (Interactive Data Analysis and Forecasting System; Ling and Roberts, 1982).

Each of the 299 practitioners in the sample formed an observation.

The actual variables employed in, or considered for, the various estimations reported in the next section were as follows:

INCOME	total fee plus salary plus sessional payments in fiscal year 1983-84
NFRAT	the ratio of non-fee (i.e. salary plus sessional) income to total income in fiscal 1983-84
HMRUD2	a dummy variable indicating that the practitioner's office address was in HMRU region 2 at the end of the fiscal year (see Figure A.1 for location)
HMRUD3 through HMRUD9	as for HMRUD2
HMR 2SH	a variable indicating the proportion of the fiscal year for which the practitioner resided in his/her end of year HMRU region. For most practitioners this was 100%.
PGBC	place of medical graduation, U.B.C.
PGOCAN	place of medical graduation was a medical school in Canada but outside B.C.
PGUSA	place of graduation, U.S.
PGUK	place of graduation, U.K.
PGOEUR	place of graduation, Europe but not U.K.
PGOTH	place of graduation, other (none of the above)
YRGRAD	year of graduation
AGE	age as of January 1, 1984
AGESQ	$(age)^2$
INC82	total fee plus salary plus sessional income in fiscal year 1982-83
SEXF	a dummy variable with value 1 - females 0 - males
FEMAGE	an interactive term: SEXF.AGE = age for females; 0 for males

FA2529	an interactive dummy variable with value 1 if the practitioner was a female aged 25-29; 0 otherwise
FA3034	as above for females aged 30-34
FA3539	as above for females aged 35-39
FA4044	as above for females aged 40-44

The logic behind the final four variables was, as noted earlier, that in addition to a general sex-related income effect, one might expect maternity-related income effects of differing magnitudes over those years.

From the original 299 observations, eight were eliminated. One general practitioner's college record showed an unknown location at the end of the fiscal year. Another practitioner in the sample billed the medical services plan for in excess of $450,000 in fiscal 1983-84, and was so clearly an outlier as to beg deletion. The other 6 were eliminated because of values for HMR2SH of less than 0.8, indicating that they had moved practice location during the year, and had been in their end-of-year location less than 80 percent of the year. Since this is likely to have an effect on activity levels, these few observations were eliiminated, leaving an N of 291.

Results

Means and standard deviations of all the variables, a simple correlation matrix for all the variables and a histogram of INCOME and ln (INCOME) are given in Tables 6 and 7 and Figure 1 respectively. The histogram of INCOME suggested that no transformation of INCOME because of its distribution was necessary. The standard deviation of INCOME was

Table 6 Means and Standard Deviations

VARIABLE	MEAN	STD. DEV.
FEE	102749.	68234.6
HMR2SH	99.8852	1.38206
SEX	0.824742	0.380830
AGE	43.3814	12.2582
PGDCAN	0.446735	0.498006
PGUSA	1.030928E-02	0.101183
PGUK	0.161512	0.368629
PGDEUR	3.780068E-02	0.191042
PGDTH	8.934706E-02	0.285733
YRGRAD	67.0206	11.9044
HMRU1	2.79725	2.37444
HMRU2	2.81787	2.37175
INCOME	106903.	65521.9
HMRUD2	0.113402	0.317621
HMRUD3	6.872851E-02	0.253422
HMRUD4	6.185567E-02	0.241302
HMRUD5	5.841924E-02	0.234938
HMRUD6	8.247417E-02	0.275557
HMRUD7	4.810996E-02	0.214367
HMRUD8	4.810996E-02	0.214367
HMRUD9	1.374570E-02	0.116634
FEMAGE	36.6392	20.4461
NONFEE	4153.86	13225.6
LNAGE	3.73353	0.265793
LNFEE	10.8093	1.94979
AGESQ	2031.70	1214.38
AGECUB	102830.	96553.0
FEE82	96420.5	72504.3
SAL82	1594.23	9390.57
SESS82	2508.46	9924.70
NFRAT	7.584858E-02	0.233178
INC82	100523.	70395.8
LNINC	11.0726	1.54146
SQRTIN	303.001	123.071
AGEST	-3.874302E-06	0.999993
SEXF	0.175258	0.380830
AG2529	7.560134E-02	0.264810
AG3034	0.195876	0.397552
AG3539	0.233677	0.423892
AG4044	0.127148	0.333706
FA2529	2.405498E-02	0.153482
FA3034	4.810996E-02	0.214367
FA3539	3.780068E-02	0.191042
FA4044	3.436426E-02	0.182476

BASED ON 291 ACTIVE ROWS

Table 7 Simple Correlations

	FEE	HMR2SH	SEX	AGE	PGOCAN	PGUSA	PGUK	PGOEUR	PGOTH
FEE	1.00								
HMR2SH	0.05	1.00							
SEX	0.29	0.07	1.00						
AGE	-0.00	0.06	0.18	1.00					
PGOCAN	-0.17	0.07	-0.00	-0.05	1.00				
PGUSA	-0.07	0.01	0.05	0.05	-0.09	1.00			
PGUK	0.16	0.04	0.03	0.12	-0.39	-0.04	1.00		
PGOEUR	0.04	0.02	-0.00	0.18	-0.18	-0.02	-0.09	1.00	
PGOTH	-0.06	-0.12	-0.11	0.02	-0.28	-0.03	-0.14	-0.06	1.00
YRGRAD	0.01	-0.08	-0.18	-0.97	0.05	-0.03	-0.17	-0.17	-0.04
HMRU1	0.18	0.06	0.07	0.01	-0.00	0.14	0.08	0.13	-0.17
HMRU2	0.17	-0.04	0.06	0.00	-0.01	0.14	0.07	0.13	-0.15
INCOME	0.98	0.05	0.29	0.00	-0.19	-0.07	0.15	0.06	-0.02
HMRUD2	-0.07	0.03	0.02	0.02	-0.04	-0.04	-0.01	-0.01	0.00
HMRUD3	0.20	0.02	0.09	0.06	-0.03	-0.03	0.14	0.02	-0.04
HMRUD4	-0.03	-0.32	0.04	0.03	-0.00	0.12	-0.07	-0.05	0.02
HMRUD5	0.07	0.02	0.04	-0.05	0.16	-0.03	-0.03	-0.05	-0.08
HMRUD6	0.07	0.02	0.07	0.01	-0.09	0.09	0.04	0.20	-0.09
HMRUD7	0.01	0.02	-0.07	0.05	-0.01	-0.02	-0.01	0.04	-0.01
HMRUD8	0.03	0.02	0.02	-0.01	0.02	0.14	0.03	-0.04	-0.07
HMRUD9	0.14	0.01	-0.02	-0.07	-0.05	-0.01	0.11	0.13	-0.04
FEMAGE	0.21	0.07	0.83	0.68	-0.01	0.06	0.09	0.08	-0.09
NONFEE	-0.30	0.03	-0.08	0.02	-0.02	0.02	-0.08	0.09	0.22
LNAGE	0.06	0.06	0.19	0.99	-0.09	0.04	0.15	0.18	0.04
LNFEE	0.78	-0.01	0.28	-0.07	-0.13	-0.04	0.14	-0.03	-0.13
AGESQ	-0.06	0.05	0.18	0.99	-0.01	0.05	0.09	0.18	0.00
AGECUB	-0.12	0.05	0.17	0.96	0.03	0.06	0.06	0.17	-0.02
FEE82	0.16	-0.05	-0.04	-0.02	0.06	-0.02	0.05	0.03	-0.07
NFRAT	-0.41	0.03	-0.20	-0.01	0.04	0.02	-0.11	0.10	0.18
INC82	0.15	-0.05	-0.06	-0.03	0.06	-0.02	0.06	0.04	-0.08
FA2529	-0.17	0.01	-0.34	-0.19	0.13	-0.02	-0.07	-0.03	-0.05
FA3034	-0.13	-0.18	-0.49	-0.20	-0.01	-0.02	-0.10	-0.04	0.10
FA3539	-0.03	0.02	-0.43	-0.10	0.00	-0.02	0.06	-0.04	-0.06
FA4044	-0.13	0.02	-0.41	-0.03	0.02	-0.02	0.07	0.06	0.01
SEXF	-0.29	-0.07	-1.00	-0.18	0.00	-0.05	-0.03	0.00	0.11

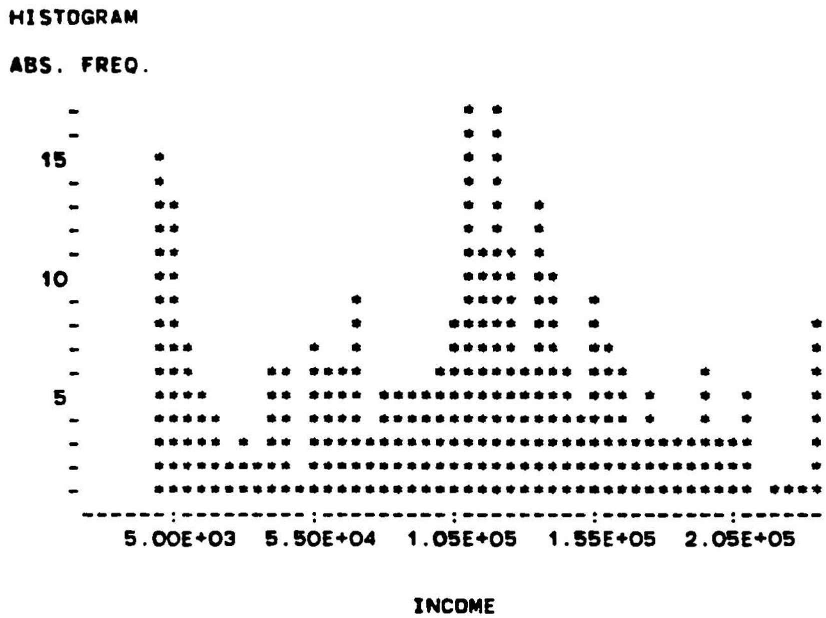
	YRGRAD	HMRU1	HMRU2	INCOME	HMRUD2	HMRUD3	HMRUD4	HMRUD5	HMRUD6
YRGRAD	1.00								
HMRU1	-0.04	1.00							
HMRU2	-0.03	0.99	1.00						
INCOME	0.00	0.17	0.17	1.00					
HMRUD2	-0.03	-0.12	-0.12	-0.08	1.00				
HMRUD3	-0.06	0.02	0.02	0.19	-0.10	1.00			
HMRUD4	-0.03	0.09	0.13	-0.05	-0.09	-0.07	1.00		
HMRUD5	0.02	0.23	0.23	0.06	-0.09	-0.07	-0.06	1.00	
HMRUD6	-0.02	0.41	0.40	0.06	-0.11	-0.08	-0.08	-0.07	1.00
HMRUD7	-0.07	0.40	0.40	0.01	-0.08	-0.06	-0.06	-0.06	-0.07
HMRUD8	0.02	0.49	0.49	0.04	-0.08	-0.06	-0.06	-0.06	-0.07
HMRUD9	0.05	0.31	0.31	0.14	-0.04	-0.03	-0.03	-0.03	-0.04
FEMAGE	-0.66	0.05	0.04	0.20	0.03	0.09	0.05	0.00	0.06
NONFEE	-0.03	-0.08	-0.08	-0.11	-0.07	-0.08	-0.07	-0.06	-0.06
LNAGE	-0.95	0.01	0.00	0.07	0.02	0.08	0.03	-0.05	0.02
LNFEE	0.09	0.16	0.17	0.72	0.05	0.14	-0.01	0.11	0.11
AGESQ	-0.96	0.01	0.00	-0.06	0.01	0.05	0.03	-0.04	0.01
AGECUB	-0.94	0.01	0.00	-0.12	0.01	0.03	0.03	-0.04	0.00
FEE82	0.04	0.18	0.19	0.15	-0.07	0.19	-0.04	0.06	0.06
NFRAT	-0.01	-0.08	-0.09	-0.26	-0.09	-0.09	-0.08	-0.07	-0.07
INC82	0.04	0.17	0.17	0.14	-0.08	0.18	-0.05	0.05	0.05
FA2529	0.19	-0.06	-0.06	-0.19	-0.06	-0.04	-0.04	-0.04	-0.05
FA3034	0.19	-0.09	-0.07	-0.15	0.07	-0.06	0.01	0.01	-0.01
FA3539	0.10	0.01	0.01	-0.02	-0.01	-0.05	-0.05	-0.05	-0.06
FA4044	0.04	0.07	0.07	-0.12	-0.01	-0.05	0.03	0.03	0.01
SEXF	0.18	-0.07	-0.06	-0.29	-0.02	-0.09	-0.04	-0.04	-0.07

Table 7 (cont'd)

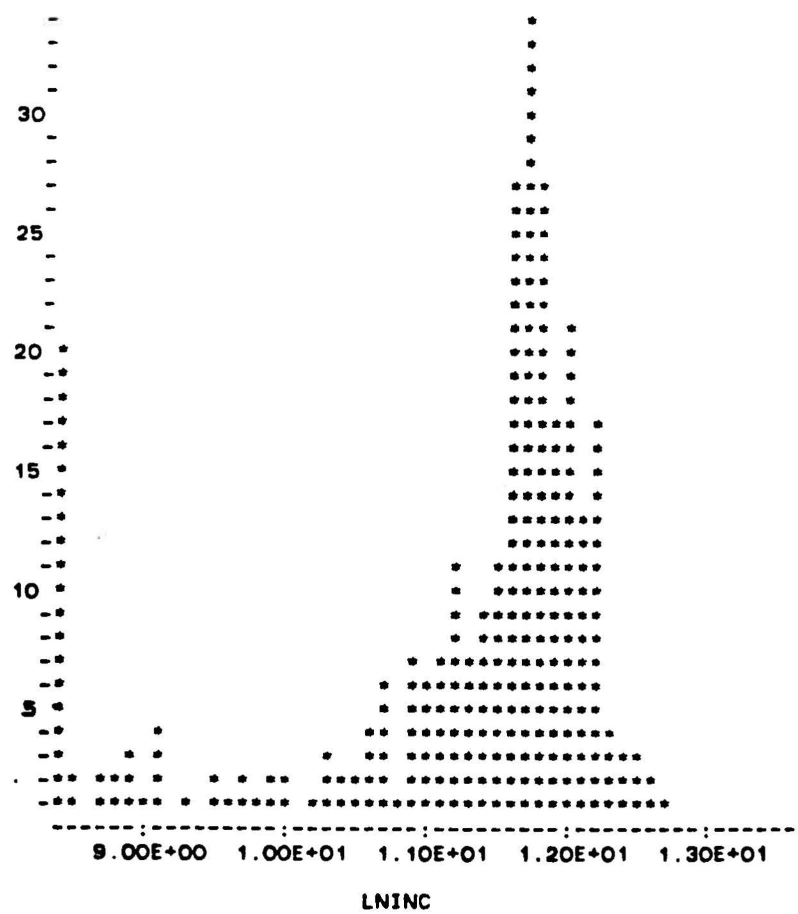
	HMRUD7	HMRUD8	HMRUD9	FEMAGE	NONFEE	LNAGE	LNFEE	AGESQ	AGECUB
HMRUD7	1.00								
HMRUD8	-0.05	1.00							
HMRUD9	-0.03	-0.03	1.00						
FEMAGE	-0.02	0.01	-0.06	1.00					
NONFEE	0.01	0.04	-0.03	-0.07	1.00				
LNAGE	0.03	-0.01	-0.07	0.67	0.04	1.00			
LNFEE	-0.01	-0.00	0.08	0.18	-0.44	-0.02	1.00		
AGESQ	0.06	-0.02	-0.07	0.68	0.01	0.86	-0.12	1.00	
AGECUB	0.07	-0.02	-0.07	0.66	-0.00	0.82	-0.16	0.99	1.00
FEE82	0.12	0.00	0.11	-0.03	-0.09	-0.02	0.17	-0.03	-0.03
NFRAT	0.02	0.06	-0.04	-0.19	0.81	-0.01	-0.65	-0.01	-0.01
INC82	0.13	0.00	0.11	-0.05	-0.10	-0.03	0.14	-0.03	-0.03
FA2529	0.07	-0.04	-0.02	-0.28	-0.04	-0.23	-0.20	-0.16	-0.13
FA3034	-0.05	-0.05	-0.03	-0.40	-0.06	-0.21	-0.02	-0.18	-0.16
FA3539	0.04	0.12	-0.02	-0.36	0.03	-0.09	-0.04	-0.11	-0.11
FA4044	0.05	-0.04	0.14	-0.34	0.09	-0.01	-0.10	-0.05	-0.06
SEXF	0.07	-0.02	0.02	-0.83	0.08	-0.19	-0.28	-0.18	-0.17

	FEE82	NFRAT	INC82	FA2529	FA3034	FA3539	FA4044	SEXF
FEE82	1.00							
NFRAT	-0.15	1.00						
INC82	0.98	-0.12	1.00					
FA2529	0.07	0.05	0.11	1.00				
FA3034	0.02	-0.07	0.01	-0.04	1.00			
FA3539	-0.07	0.09	-0.06	-0.03	-0.04	1.00		
FA4044	0.08	0.09	0.07	-0.03	-0.04	-0.04	1.00	
SEXF	0.04	0.20	0.06	0.34	0.49	0.43	0.41	1.00

Figure 1 Sample Distribution of INCOME and ln(INCOME)



MEAN = 1.0690E+05
STD. DEV. = 6.5522E+04
SAMPLE SIZE = 291



MEAN = 1.1073E+01
STD. DEV. = 1.5415E+00
SAMPLE SIZE = 291

$65,522, on a mean of $106,903. The only simple correlations that were potentially problematic were AGE and YRGRAD (year of graduation) (-0.97), AGE and AGESQ (0.99), FEMAGE and SEXF (0.83), and FEMAGE and AGE (-0.68). Age was used instead of YRGRAD, and FEMAGE was not used for correlation and theoretical reasons. The inclusion of both AGE and AGESQ is not a serious problem with a predictive model such as that being developed here. The idea behind the FEMAGE variable was that there may be age-specific sex differences. However, the form of this particular variable imposes a sex differential that is a linear function of age. Since such a hypothesis is no more nor less likely to be true than a constant differential (as would be picked up by a straight SEXF variable), and because of the high correlation of AGE, SEX and FEMAGE, the variable was dropped in favour of the selective female age group interaction dummy variables.

Six separate regressions were performed using different sets of variables (see Table 8). Briefly, the initial analysis indicated the need for a quadratic form of the age variable (AGE, AGESQ). A linear age variable was unable to explain any of the variance of INCOME around its mean whereas a quadratic form (INCOME = aAGE + bAGESQ) was able to account for over 21 percent of that variance in INCOME. Both parameters were significantly different from zero ($p<0.01$), and the standard error of estimation fell from 65,635 (with only age) to 58,211 with the quadratic form. Equation 3 represents the first attempt to begin testing the full model. The region and place of graduation dummy variables are added, as well as the SEXF dummy (male = 0; female = 1) and NFRAT. With a critical value for $F_{0.05}(16,274)$ of about 2.04, the null hypothesis $H_0:\beta_1 = \ldots = \beta_{16} = 0$ can be rejected at a 95% confidence level. The critical t-value

$t_{0.025}(274) = 1.96$, so that individual parameter null hypotheses $H_0:\beta_i = 0$ can be rejected at the 95% confidence level for SEXF, PGOCAN, HMRUD3, and HMRUD9. It is interesting to note, however, that AGE and AGESQ alone produce a higher $\bar{R}^2$ and lower s_e than linear AGE plus the other 15 independent variables. The logic of including an AGESQ term is also clearly portrayed in the plot of residuals vs. AGE from equation 3 (see Figure 2).

With equation 4 (Table 8) we are able to test the significance of the variables other than AGE and AGESQ, by performing an F test of significance on a comparison of equations 2 and 4. Using the R^2 values for each equation, and noting that k=15 additional variables and p=2 original variables in equation 2, we have

$$F = \frac{R_4^2 - R_2^2}{(1 - R_4^2)} \cdot \frac{273}{13} = 6.764$$

The critical $F_{0.05}(13,275)$ value is 2.24, so one can reject the hypothesis $H_0:\beta_{p+1} = \ldots = \beta_k = 0$ at this level of confidence.

Equation 5 in Table 8 is the same as equation 4, with the addition of INC82. Surprisingly, one cannot reject the null hypothesis for the coefficient on this variable: prior year income appears to have little effect on current activity levels.

The final equation (6) attempts to test the hypothesis that, in addition to a general sex differential, there may be specific maternity-related differentials during specific age periods (25-29, 30-34,

Table 8 Preliminary Analyses of G.P. Life-Cycle Activity Levels, Dependent Variable Income

INDEPENDENT VARIABLE	1		2		3	
	Estimated Parameter	t-value (H_o:β=0)	Estimated Parameter	t-value (H_o:β=0)	Estimated Parameter	t-value (H_o:β=0)
AGE	1.103	0.004	17,737.	8.826	-312.97	-1.036
AGESQ			-180.78	-8.912		
SEXF					-43,296.	-4.517
PGOCAN					-21,707.	-2.465
PGUSA					-56,795.	-1.590
PGUK					4,410.1	0.385
PGOEUR					13,690.	0.666
PGOTH					7,718.1	0.553
HMRUD2					-15,615.	-1.358
HMRUD3					40,505.	2.809
HMRUD4					-9,821.4	-0.653
HMRUD5					23,063.	1.495
HMRUD6					9,687.3	0.711
HMRUD7					14,814.	0.892
HMRUD8					25,074.	1.491
HMRUD9					70,880.	2.300
NFRAT					-55,657.	-3.485
INC82						
FA2529						
FA3034						
FA3539						
FA4044						
CONSTANT	108,860	7.540	-295,280.	-6.304	91,912.	6.024
R^2	0.0		0.216		0.233	
$\bar{R}^2$	0.0		0.211		0.186	
S_e	65,635		58,211		59,041.	
F	0.0		39.71		5.20	

Table 8 Preliminary Analyses of G.P. Life-Cycle Activity Levels, Dependent Variable Income
(continued)

INDEPENDENT VARIABLE	4		5		6	
	Estimated Parameter	t-value (H_o:β=0)	Estimated Parameter	t-value (H_o:β=0)	Estimated Parameter	t-value (H_o:β=0)
AGE	16,895.	8.697	16,849.	8.688	17,686.	8.650
AGESQ	-174.63	-8.943	-174.05	-8.927	-181.50	-8.911
SEXF	-42,052.	-4.978	-43,112.	5.093	-60,559.	-3.164
PGOCAN	-8,835.8	-1.120	-9,789.9	-1.238	-9,017.2	-1.138
PGUSA	-36,018.	-1.142	-35,992.	-1.143	-34,678.	-1.109
PGUK	-6,115.6	-0.602	-6,775.1	-0.667	-6,566.9	-0.646
PGOEUR	14,603.	0.806	13,511.0	0.747	15,633.	0.869
PGOTH	-4,002.9	-0.324	-3,919.4	-0.318	-1,214.0	-0.098
HMRUD2	-19,122.	-1.885	-18,665.	-1.843	-18,685.	-1.849
HMRUD3	28,888.	2.262	25,477.	1.964	25,812.	2.000
HMRUD4	-11,753.	-0.887	-11,445.	-0.866	-9,408.3	-0.714
HMRUD5	20,513.	1.509	19,376.	1.425	21,757.	1.604
HMRUD6	4,069.4	0.338	2,860.9	0.238	4,083.2	0.341
HMRUD7	27,366.	1.863	24,252.	1.635	25,571.	1.729
HMRUD8	18,601.	1.254	17,839.	1.204	13,709.	0.924
HMRUD9	74,890.	2.758	70,848.	2.600	79,385.	2.902
NFRAT	-59,399.	-4.220	-56,996.	-4.027	-52,477.	-3.613
INC82			0.0646	1.410	0.0752	1.639
FA2529					20,079.	0.699
FA3034					25,345.	1.043
FA3539					47,836.	1.935
FA4044					-13,898.	-0.559
CONSTANT	-300,150.	-6.546	-305,760.	-6.655	-286,290.	-5.876
R^2	0.407		0.411		0.428	
$\bar{R}^2$	0.370		0.372		0.381	
Se	52,019.		51,925.		51,546	
F	11.01		10.54		9.12	

35-39,40-44). The insignificant (p>0.05) parameter estimates on all four of these are puzzling, but some possible explanations are offered below. The $\bar{R}^2$ increases from equation 5 to 6 only slightly (from 0.37 to 0.38), and s_e falls marginally (from 51925 to 51546). Another inter-equation F-test comparing equations 5 and 6 yields an F-value of 1.99, insufficient to allow rejection of the null hypothesis that the FA dummy variables add explanatory power to the model.

It would appear, then, that less than 50 percent of the variation in income can be explained by age, sex, location, place of graduation, previous year's income, and method of payment (NFRAT). Of course this poses serious problems for the potential of this model as a predictive model of income or activity levels. However, it is less critical to its potential as a component of a supply availability model, since a wide range of income levels may be associated reasonably with the availability of a full time physician. In any event, more work remains, but it will require data not now readily available, and perhaps a different approach to measuring the dependent variable. In the following sections of the present paper, the results presented as equation 6 are interpreted, both from a purely quantitative perspective and from the perspective of attempting to explain counter-intuitive results.

IV. INTERPRETATION

The estimated parameters on the AGE and AGESQ variables are as one would expect. Incomes tend first to increase, then to decline with AGE.

If one differentiates the equation INCOME = 17686*AGE - 181.5*AGESQ with respect to AGE, sets the partial derivative to zero, and solves for AGE, one finds that these results suggest an income peak at about 48.7 years of age. While this result needs to be treated with caution because of the extreme collinearity between AGE and AGESQ, examination of the mean age (about 43 years), and a plot of INCOME vs AGE, suggests that a quadratic might quite reasonably peak between the ages of 45 and early 50's. These parameter estimates imply that, all else equal, a physician of 35 would be expected to earn about $30,000 more than his/her 30 year old colleague, but a 60 year old might earn about $16,000 less than a physician of 55.

Turning to the sex variables, both general and specific effects were postulated. The estimated parameter on SEXF implies that females, on average, earn about $60,500 less than their male counterparts. However, this is a fair bit larger than the impact implied by equation 5 (a differential of $43,000 favouring the males, and can be attributed to inclusion of the four specific age group female dummy variables. Yet we cannot reject a null hypothesis of no differential effect for any of those specific variables. This suggests that the 'true' average differential may be closer to $45,000 than to $60,000. The results on the FA dummy variables are particularly curious. If one could reject a null hypothesis for any of them at a reasonable confidence level (and the t-value on FA3539 suggests that one could be at least 90% confident if doing so for that variable), these parameter values imply that, for example, a female physician aged 35-39 can expect to earn, on average, about $13,000 less ($60,559-$47,836) than her male colleague of the same age, location, etc. This is a far cry from $60,000, if it could be believed. One might develop a convincing story about female physicians retiring earlier and being closest in 'productivity' to their male counterparts during the early and mid-career years. Then the parameter on SEXF could be argued to be picking up the effects of the older cohorts, while the younger physicians are able to close the income gap. This would not be inconsistent with findings from other jurisdictions reviewed above. But at least equally probable is that the estimation of a time series phenomenon using cross-section data is biasing these parameter estimates because the cross-section cannot take account of the complete absence of physicians. If a female practitioner leaves her practice for one or more complete years during the age interval 25-44, this would not be picked up. This suggests the need for a pooled time series, cross-section data set comprised of eight to ten consecutive years' history for a sample of practitioners known to have resided in the province for that entire period. If those practitioners do not appear on income records for particular subsets of those years, one can then insert the appropriate values for the other variables, and zero income. This would then fully capture any maternity effects within the data set.

The variable NFRAT represents the proportion of INCOME that was non-fee-for-service. Physicians with a high value of NFRAT would be expected to have lower incomes, and vice versa, because full time salaried positions for physicians in the province have gross pay levels considerably lower than the <u>gross</u> income potential of a fee practice. Thus, there are two effects. First, physicians paid exclusively or primarily by salary and session, will tend to have lower net (but before taxes) incomes than their fee-for-service counterparts; and second, one is mixing gross pay in the case of fees with net pay in the case of salary, although sessional fees should cover practice expenses much like service fees. The estimated parameter value of -52,477 is significantly different from zero (at a 99% confidence level), and implies that a practitioner who earns 50% of his/her income through non-fee practice will, on average and other things equal, earn about $16,000 less than a practitioner earning 80% of income through fee practice. A physician involved in no fee-for-service will earn, on average, $52,000 less than an exclusively fee-for-service general practitioner.

The final variable in the model is INC82, a variable that one might reasonably expect would play a major, even a dominant, role. Its inclusion is based on the premise that $INCOME_t$ will bear a close relationship to $INCOME_{t-1}$. This variable introduces a time series component to this essentially cross-section model, and no complete explanation for its lack of significance can be offered at this time. One clear problem revealed by an examination of the data is the failure to capture the apparent phenomenon of starting physicians who purchase established practices and therefore move from $0 in one year to >$100,000 in the next. There is a surprising amount of variation in the incomes of young physicians, and this model has no current capacity to explain that. This represents a major area requiring further investigation, but it is also an area that cannot be fully explored with the data currently available. Another potential problem with the INC82 variable is that, whereas the 291 observations in the sample are all physicians who spent most of 1983-84 in one region, we cannot vouch for their locational stability during the previous fiscal year. Some may have been in active practice outside B.C. for part or all of 1982-83. These data are available, and will permit paring of the sample in the next stages of this investigation (on a larger data set). We fully expect that resolution of some data problems, and incorporation of information on physicians who purchase rather than set up new practices (if available), will render this variable far more significant.

The fact remains that at the end of the day, fully 60% of the variation in income is left unexplained by this model. Data improvements and model modifications such as those noted above can be expected to add some explanatory power. But there is a large component of variation in income which, one suspects, reflects the fact that some physicians take longer holidays than others, some work longer hours each day than others, and some are more adept at 'revolving the door' than others. One might have expected previous year's income to proxy these differences to some extent, and perhaps after some of the considerations noted above are taken into account it will do a better job. But even individual practitioners have the option of adjusting holiday time, hours of work, and style of practice from one year to the next. There are clearly many interesting questions remaining to be explored, but given the exploratory nature of this research and the lack of comparable research from other jurisdictions, one would be surprised not to be left with more questions than answers at this stage.

V. POLICY IMPLICATIONS

There are, however, a small number of implications for physician supply forecasting that it seems safe to draw out from these results. First, and most obvious, is the evidence that general practitioners do retire gradually. Using equation 2 for simplicity, we have a retirement pattern running from an income of about $94,000 at age 65, to about $60,000 at age 70, and full retirement not being reached, on average, until close to age 77. Of course even the quadratic form may not be sufficiently flexible to pick up changes in retirement rates with advancing age. A dummy variable approach is one of the intended extensions to this research. In addition, there seems little doubt that female physicians tend to earn less than their male counterparts. The specific age pattern of this differential is as yet unclear, and the implications for manpower planning are even less clear. In a 'market' where utilization is apparently causally linked to supply, it is somewhat difficult to argue that an increasing proportion of female physicians will increase physicians requirements!

Future extensions to this research will also include analyses of other specialties. Of particular interest will be significant differences between specialties in apparent retirement choices and in the strength of sex-related activity differentials.

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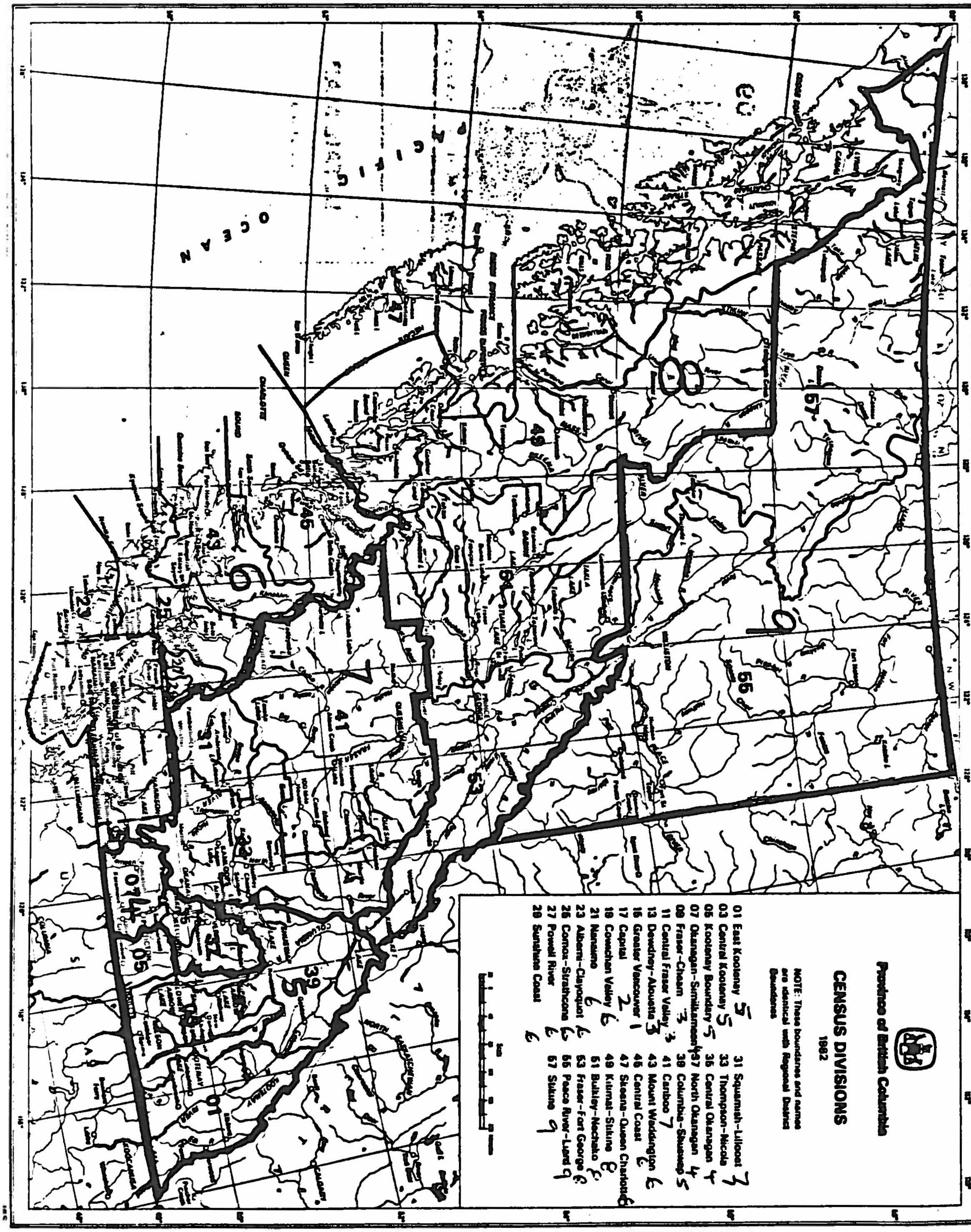
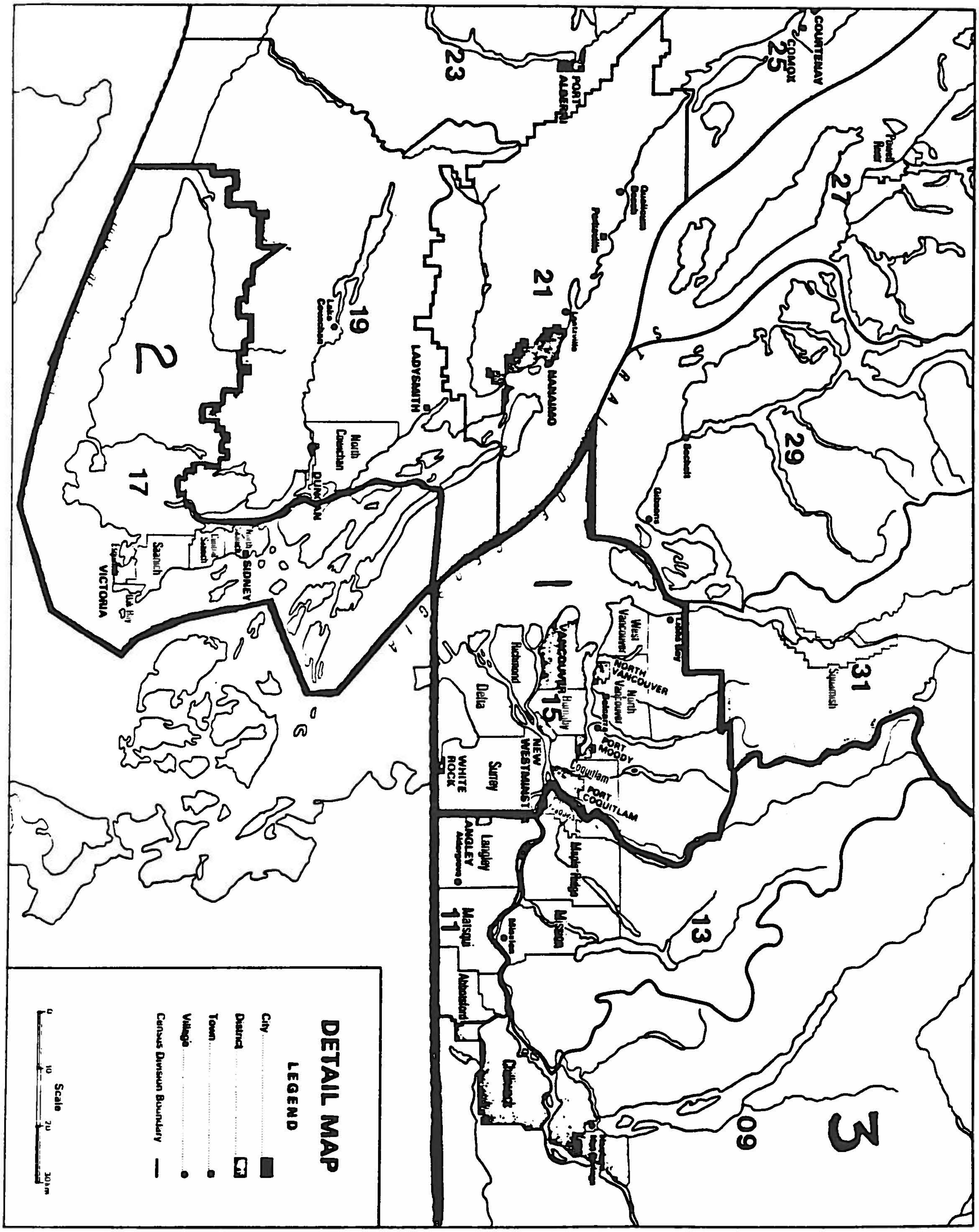
APPENDIX A

Appendix A

Health Manpower Research Unit Regions




DETAIL MAP
LEGEND
City
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Village
Census Division Boundary
Scale
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30 km
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19
21
23
25
27
29
31
1
15
13
11
09
3
VICTORIA
Saanich
SIDNEY
DUNCAN
North Cowichan
Lake Cowichan
LADYSMITH
NANAIMO
PORT ALBERNI
COURTENAY
COMOX
Powell River
Sechelt
Gibsons
Squamish
West Vancouver
NORTH VANCOUVER
North Vancouver
VANCOUVER
Burnaby
Richmond
Delta
Surrey
WHITE ROCK
NEW WESTMINSTER
PORT MOODY
Coquitlam
PORT COQUITLAM
Maple Ridge
Mission
Langley
LANGLEY
Matsqui
Abbotsford
Chilliwack

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