REFERRAL PATTERNS, FULL-TIME-EQUIVALENTS AND THE 'EFFECTIVE' SUPPLY OF PHYSICIAN SERVICES IN BRITISH COLUMBIA*

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I. INTRODUCTION

By any reasonable method of counting, the supply of physicians in Canada, and particularly in British Columbia, has been increasing at rates in excess of general population growth for some time now.[1] This has led to growing concern about real or potential oversupply of physicians in certain areas and specialties, while at the same time causing other concerns because of the failure of this rapidly expanding stock to alleviate putative geographical and specialty maldistribution.

At the national level these concerns have surfaced most recently in the so-called Hall Review (6), the Law report (7) recommending a ten per cent cut in medical school enrolments, and the currently ongoing joint federal-provincial physician manpower study being carried out under the auspices of the Federal/Provincial Advisory Committee on Health Manpower. Activity appears to have been equally frenzied within at least some of the provinces. Ontario has been active in this regard in recent years (8,9), and in B.C. (the source of data for this paper) recent developments include deliberations of a Joint Committee on Medical Manpower in the fall of 1982, and hints in the latest provincial

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1 While different methods of measuring supply occupy centre stage in later sections of this paper, one national source of supply data shows increases in active civilian physicians in Canada and B.C. respectively, of 39.6% and 48.8% over the period 1971-81 (1,2). Census figures for those two years show population growth of 12.9% and 25.9% respectively (3,4). Evans (5) provides data showing similar trends over the earlier 1957-71 period.

budget and accompanying draft legislation (July 1983) of restrictions on provincial medical plan billing numbers.

In short, physician services planning has become both a high profile and a high growth industry. This activity is, of course, necessitated by the nature of the sector. Despite rhetoric to the contrary, traditional competitive forces acting through a price nexus play no significant role in the 'market' for primary health care services (10,11). Nor should they (12). But when left to its own devices, indications are that the sector would be quite comfortable gorging itself on ever larger slices of GNP and GPP pies, all of which brings us to the rationale for physician services planning.

One of the key stages in manpower planning for any occupational group is of course "data collection and analysis" (13). The objective of this stage is primarily the determination of current and future net personnel requirements (aggregate requirements less available supply, given wage or income levels). The procedural steps within the 'current' phase of this stage consist of current supply estimation, estimation of current demand/need/requirements as the case may be (14), and determination of net current requirements (used loosely here to refer either to demand, need or requirements depending on the requirements side methodology (15)). Similar steps comprise the 'future' phase of this stage, with the added methodological complexities of forecasting thrown in.

Estimation of requirements, whether need- or demand-based, tends to be viewed as the more complex side of the quantitative stage, whether because of definitional ambiguity or data insufficiency or both. This has resulted in a disproportionate concentration of research effort on supply side estimation (15). Despite (or because of) this attention, methodological approaches to supply side estimation and forecasting are as varied as they are numerous.

However, the intent of this paper is neither to focus on the less tractable requirements side of the quantitative stage, nor to report yet one more causal analysis of physician locational decision-making (16-23). Rather, we attempt to accomplish two rather unpretentious tasks relating to supply side estimation: investigate the empirical impact of different approaches to measuring aggregate stock; and assess the effect of looking at the distribution of physician services from the locational perspective of the patient rather than the provider.

It is not just variability in modelling or forecasting methods which generates variety in approaches to quantifying the supply side. Even within the ostensibly straightforward task of determining current supply (without regard to its causal underpinnings), there are a number of dimensions of potential variation. At the simplest level of stock measurement there is the question of whom to include (or exclude). Then there are the issues of full-time-equivalents (fte) or bodies, and age/sex mix. The method of categorizing practitioners into specialty groups may be important, as may the method of fte determination. Finally, imposed on each of these dimensions, will be approaches to determining geographical distribution. Yet despite the attention given to the "supply side", except in the context of income-related research (24,25) the stage of actually quantifying stock has not generated widespread interest (26).

The approach to current supply side estimation in any given situation will, first and foremost, be determined by the nature of the question being addressed, secondarily by data availability and methodological sophistication. Thus one might include all practitioners registered with a provincial college for some purposes, but only active fee-for-service practitioners for others. Similarly, educational policy must deal with bodies while issues of service provision are often more appropriately dealt with from an fte perspective. If current supply is to be used as the basis for projection, age and sex distribution become important, and depending on the specificity of the question(s) being addressed by the intended projection, specialty and geographic location may be necessary ingredients of the base.

The objectives of this paper, then, are two. Using a comprehensive provincial database, we address the question of the impact of definitional variation on estimates of physician supply. A number of generic approaches to supply measurement are described and then applied to the common database.

The second question addressed by this paper deals with approaches to quantifying geographic maldistribution. We argue that inter-regional physician population ratios based on the physician's practice location are less appropriate for this purpose than inter-regional age/sex adjusted utilization patterns. This issue takes on some importance if one believes (as we do) that it is unrealistic (as well as being bad policy) to use even an age/sex adjusted physician/population ratio equal across regions as a distributional target for all specialties. Here we look at inter-regional distribution in B.C. by specialty, using three approaches: fte physicians per capita based on pegging physicians to the regional hospital district (RHD) in which they have their offices; age/sex adjusted per capita expenditures; and fte physicians per capita based on allocating physicians to the estimated regions of their patients. The last two approaches are complicated in British Columbia by a combination of missing and inaccurate locational information for the provincial medical plan subscribers. For some subscribers through group plans, the MSP has no address, but more fundamental is the unknown accuracy of the many addresses the Plan does have.

In the following section we detail our sources of data. Section III addresses the issue of supply measurement definitions, Section IV tackles regional distribution and in Section V we attempt to draw some guidance for policy and future research from the results.

II. DATA SOURCES

As was noted above, the data on which the analyses were undertaken are from a single province -- British Columbia. They are also from a single year - fiscal year 1981-82, or a single point during that year. Two sources of data were employed, and merged where necessary. From the records of the College of Physicians and Surgeons of B.C. (CPSBC) came calendar year information on registration status, College specialty designation, and RHD. The Medical Services Plan of B.C. (MSP) provided detailed data on utilization and plan payments for the fiscal year 1981-82. These data included service-specific fields detailing attending physician, referring physician, age and sex of patient and amount paid, which allowed the generation of information aggregated to the level of the physician, a specialty cohort, a region, or combinations. In addition data were obtained from the MSP on salaried and sessional payments to practitioners during that year, and on each fee for service physician's 'type of practice'.

A physician's type of practice specialty may differ from the specialty in which (s)he holds College registration. Each item in the MSP Schedule of Benefits is grouped within an MSP specialty designation. A physician's type of practice is then that MSP specialty category within which his/her greatest proportion of billings falls. This distinction takes on some importance, for example, in the case of rural general practitioners functioning as anaesthetists.

The MSP Statistics Master File contained 37 million payment claims records for fiscal year 1981-82. About 90 per cent of these were used in the analyses of Section IV of this paper[2]. Processing this large number of records was necessitated by the earlier noted absence of patient location information. While summary per capita expenditure data were available directly from the Plan, all such data are based on the RHD of the attending physician. Even the detailed records were not sufficient to allow definitive location linkage for about one-half the patients. Accordingly, we used the service-specific information on referring physicians to proxy patient location. The rationale and method are described more completely in Section IV.

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2 Excluded were records of optometrists, dental surgeons, chiropractors and other non-medical practitioners who billed the plan, plus all records for services rendered by physicians not resident in B.C., to residents of the province.

III. THE CURRENT SUPPLY OF PHYSICIANS IN B.C.

We have attempted to portray the dimensions of variability impacting on physician supply measurement in Figure 1. It is a hierarchical structure[3] with four levels. Each level represents one of the dimensions affecting one's approach to deciding whom and how to count.

The first and most basic question which must be addressed is "what is a physician"? While this may initially strike one as trivial, in fact it is anything but (27). It is insufficient to argue that a physician is anyone who practices medicine, because many physicians do not. One is on equally shaky ground with an educational criterion -- e.g. everyone with medical training, an M.D. (or a D.O.; doctor of osteopathy), although this is a commonly applied criterion (24,25). The comprehensiveness of medical education varies with country if not school. Furthermore, practitioners such as osteopaths, naturopaths, chiropractors, optometrists, midwives and nurse practitioners (to name but a few) may perform service overlapping 'traditional medicine' without having identical training. Some of these may argue for physician-equivalent status; others may not. But neither practice nor training provide watertight criteria with which everyone would be satisfied for all purposes.

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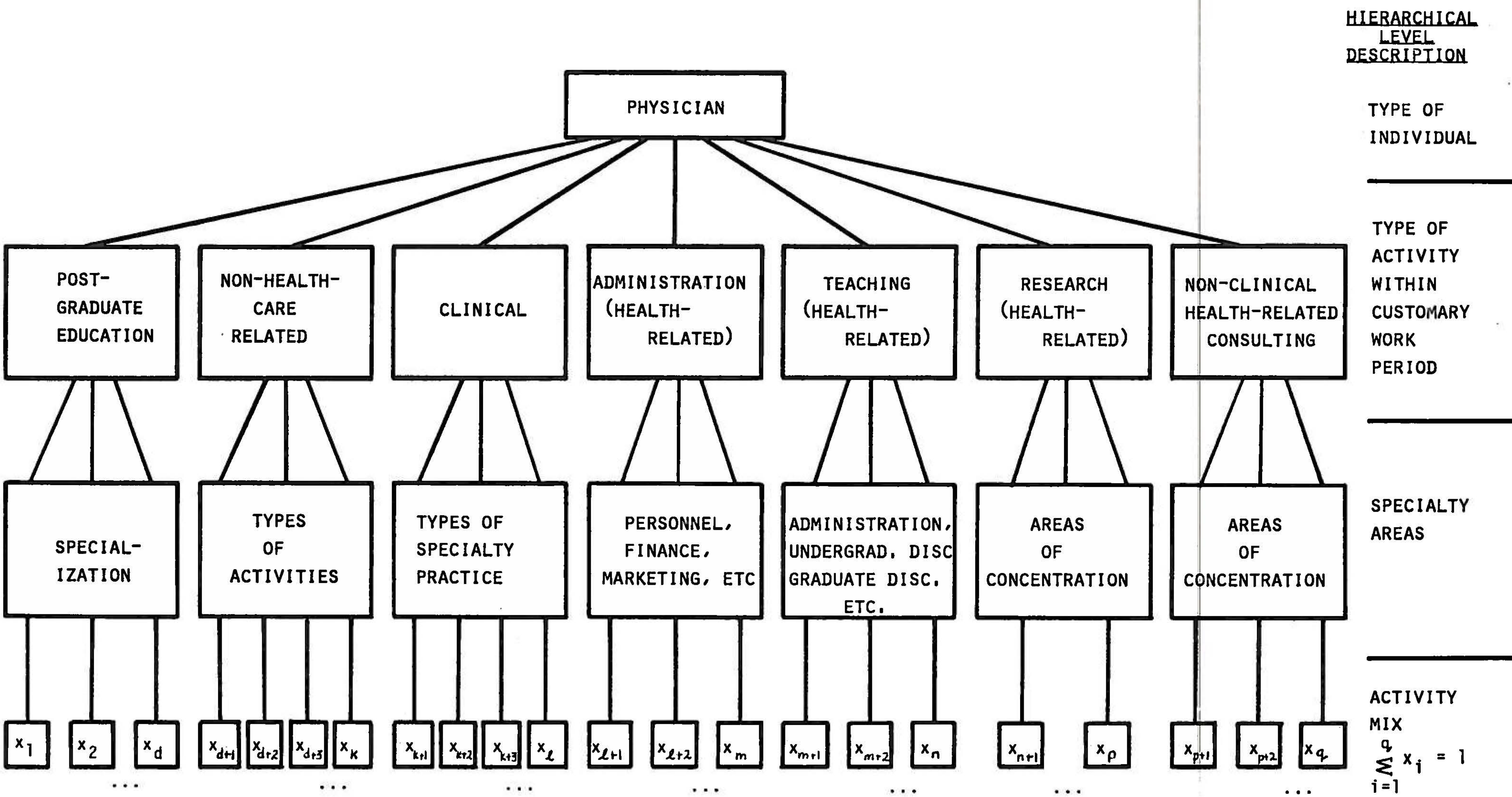
3 That is, the relationships of each level to the level immediately below it in the hierarchy are 1:N ($N \geq 1$).

Figure 1: A Hierarchical Representation of Characteristics Affecting the Determination of Current Physician Stock



What, then, is a physician? Rather than attempting to create an acceptable conceptual definition, we have opted for a third criterion -- licensure -- as an operational definition. All practitioners registered with the provincial licensing body (the CPSBC) and therefore licensed to practice medicine (or osteopathy) are considered to fall within our working definition of "physician". This will leave out some traditionally trained physicians who are not involved in clinical practice and do not bother to pay registration fees to the College. At least some of those will be involved with medicine in some way (e.g. teaching or research). Among the professional groups noted above, this definition includes osteopaths but excludes the rest.

The validity of this approach again depends on the questions being addressed. If those questions concern potential clinical capacity (including those not involved but who might somehow be induced to re-enter practice), or teaching/research capacity, this definition has some obvious problems. In B.C. the latter problem can be minimized by a reconciliation of College records and persons involved in teaching or research (who by and large will be affiliated with the single provincial medical school). The administration variant of this problem would be somewhat more difficult to overcome because of the diversity of sites and positions. But in most cases and for most purposes, this provides a reasonably accurate working definition.

Only rarely, however, will a simple count of everyone in level 1 of this structure serve the supply measurement purpose (28). More commonly, one will be interested in a subset of practitioners, and/or in an uneven weighting of those practitioners. The remaining levels of Figure 1 are intended to portray those possibilities.

The second hierarchical level reflects types of activity. Each person satisfying our definition of physician will be involved in one or more of post-graduate education, clinical practice, administration, teaching, research, non-clinical consulting, and other activities unrelated to medicine or health care. It is this level which begins to make clear the importance of one's question to the supply count which answers it. "How many physicians are there in B.C.?" may mean how many persons are at level 1, or it may actually be soliciting information on only a single cell at level 2.

Within each broad activity are, of course, an inordinate number of specializations and sub-specializations. The third level could, in fact, be multiple levels in the hierarchy. Thus, within the broad activity of teaching, a practitioner may be involved in educational administration, or graduate or undergraduate teaching. Clinical practice may similarly be subdivided into types of specialization.

Finally, level 4 represents the full-time-equivalent conversion of level 3, thus bearing a 1:1 relationship with that level. In each cell of level 4 is the proportion of the practitioner's customary working time falling within its corresponding level 2 and 3 activity/specialty combination. The cells of level 4, being proportions of work time, will sum to 1.0. A retired practitioner who, however, is registered with the CPSBC would show a string of zeros with the exception of the level 4 'child-cells' of the non-health-related activity node.

Approaches to Measuring Clinical Stock

Our interest in this paper is in the measurement of current clinical capacity. This narrows our focus within the framework to the corresponding node on level 2 of Figure 1, plus its 'child nodes' in the lower branches. Of course the precise determination of the appropriate x_i ($k<i<\ell$) would require detailed information on all branches of the hierarchical tree for each practitioner. Much of our research effort constitutes, in fact, attempts to compute $\sum_{i=k+1}^{\ell} x_i$ without that supplementary other-activity information.

Given a definition of a physician tied to licensure/registration with the provincial College, that seems a natural place to begin our efforts at quantification. The CPSBC records allow classification of physicians into three broad categories: directory active in B.C., directory active not in B.C., and not directory active.
Included in the last are all physicians who are retired, suspended, or deceased. Directory active physicians fall, in turn, into one of two broad sub-categories: non-postgraduate or postgraduate. The latter represents practitioners involved in post-M.D. training (e.g. intern, resident, or clinical fellow). Postgraduates are further subdivided into "paying" and "non-paying", the significance of that being that the former, upon receipt of a valid practitioner number, are permitted to submit fee-for-service claims to the provincial MSP.

As of March 31, 1982, there were 7,094 directory active physicians registered with the CPSBC. Of these, 5,684 resided in B.C. These figures both include, however, physicians who ought not to be included in an estimate of clinical stock. We may narrow the focus slightly by determining the number of practitioners who were "non-postgraduate directory active in B.C." or "postgraduate paying directory active in B.C.". This amounted to 5,306 at the same date.

While this figure reflects an overt decision regarding level 1 of the hierarchy, and an attempt to focus on the clinical node of level 2, it embodies no cognizance of the variability implied by levels 3 and 4. In fact, for the present purpose of estimating aggregate stock, level 3 is unimportant and our interest is in $X_C = \sum_{i=k+1}^{\ell} x_i$ (clinical full-time-equivalence) in level 4. More practically important for aggregate estimation purposes, level 2 is also as far as we can push the data collected by the CPSBC.

When one moves over to the data collected and generated by the MSP, the level 1 definition of a physician can be maintained because virtually all practitioners seeking reimbursement from the Plan for the rendering of medical services must be registered with the CPSBC. They will also, incidentally, be either "non-postgraduate directory active" or "postgraduate paying directory active". What they need not necessarily be is resident in B.C., although the vast majority are.

The MSP data are of primary use in addressing level 4 of our hierarchical framework (fte's). However, for the purposes of comparison one might attempt to estimate the clinical node of level 2 by counting all physicians paid by the MSP during a period sufficiently long to incorporate most of those 5,306 physicians constituting our most refined CPSBC-based estimate. It turns out that such a comparison is precluded by the billing arrangements for many of the pathology and radiology practices in the province. Each such practice bills the medical plan through a single payee number. Except for solo practices, this number does not necessarily correspond to any individual physician's MSP billing number. As a result, one has multiple physicians billing through a single administrative number. The effect of this arrangement is an inability to identify individual practitioners in pathology and bacteriology, medical microbiology, and radiology practices, using MSP data.

Even if this were not the case (i.e. if each practitioner were required to bill personally for services rendered or overseen in such diagnostic practices and there were no privately salaried practitioners in those practices), one would still not expect precise comparability of the CPSBC- and MSP-based estimates for three reasons. First, an MSP fiscal year count would be based on date of payment rather than date of service. It is conceivable, then, that a physician might render no service during fiscal year 1981-82, might not be registered with the College, and yet could be counted among those paid by the Plan. Of more import is the more obvious fact that the College figures represent a point-in-time while the MSP count is for an entire fiscal year. The third factor is that some practitioners not involved in clinical activities will nevertheless be fully registered with the College. To the extent that these factors do not balance out, one will expect discrepancies.

During the fiscal year April 1, 1981 through March 31, 1982, 4,857 physicians (not including the above-noted types of practice) received remuneration in the form of fee-for-service, salary and/or sessional pay, from the MSP for services performed in B.C. Of those, 4,795 resided in B.C. for at least part of that fiscal year. The net effects of the fiscal year vs point-in-time, service date vs payment date and clinical vs non-clinical discrepancies are illustrated in Table 1. In this table we have compared two CPSBC-based categorizations with the number of practitioners paid by the MSP, for those types of practice for

Table 1

N U M B E R S O F P H Y S I C I A N S

by Type of Practice

Type of Practice	Directory Active BC March 31, 1982 Non-PG	Directory Active BC March 31, 1982 PG Paying	Remunerated[1] by MSPBC April 1, 1981 to March 31, 1982
Anaesthesia	263	0	273
Dermatology	45	0	43
Ear, Nose & Throat	64	0	68
General Practice	2,887	63	2,890
Internal Medicine	350	2	335
Medical Microbiology	9	0	*
Neurology	42	0	42
Neurosurgery	26	0	25
Nuclear Medicine	3	0	2
Obstetrics & Gynaecology	141	0	139
Ophthalmology	144	0	143
Orthopaedic Surgery	117	1	111
Osteopathic	2	0	4
Paediatrics	135	0	135
Pathology & Bacteriology	127	2	*
Physical Medicine	21	0	17
Plastic Surgery	31	0	32
Psychiatry	271	0	280
Public Health	33	0	17
Radiology	211	0	*
Surgery - General	235	1	225
Thoracic Surgery	20	0	18
Urology	60	0	58
TOTAL	5,237	69	4,857

[1] This includes all fee for service, salaried and sessional payments.
* These numbers are not presented because of the diversity of billing patterns among these physicians.

which comparison is possible. In general, the column 3 figures seem more frequently slightly lower than the sum of columns 1 and 2, suggesting that the dominant consideration is the over-estimation of clinical personnel by the College classifications.

But the number of practitioners receiving payment from the MSP during the fiscal year also significantly overestimates medical service capacity as represented by the equivalent number of practitioners providing clinical service on a full-time basis.

Approaches to estimating full-time-equivalent (fte) clinical stock range from simple to convoluted, simplistic to imaginative. In general, the rule that simple answers to simple questions are usually wrong applies in spades. A full-fledged review of those approaches would draw us rather swiftly into the familiar problems of output and productivity measurement --- is a practitioner who sees patients 15 hours a day but provides no service impacting on health status a greater part of clinical stock than a practitioner removing erupted appendices from children for three hours a day? Rather, we take a cursory step past the issues of output measurement to focus on clinical capacity -- that is, full-time-equivalents licensed and (therefore at least theoretically) able to provide efficacious clinical service. Then the measurement of fte stock becomes a problem of activity measurement.

There appear to be two general approaches to activity measurement -- the direct approach and the indirect or proxy approach. The former keys on hours of clinical practice (hours per day and days per year), and requires data collection by questionnaire (29). But surveys of this type are subject to various forms of bias, particularly when they deal with issues of hours of work or incomes. Thus we find the MacDonald Report (9) citing (and using[4]) self-reported average yearly hours of work data gathered by the Ontario Medical Association which imply that the average physician works 57 hours per week, 45 weeks per year (or equivalent combinations excluding on-call time). More amazing still are the Ontario neurosurgeons (averaging 3,170 hours per year) and urologists (averaging 2,928 hours per year).

Because direct input (own-time) measures are difficult to pry from practitioners, and seem suspect even when relinquished, one tends to turn to measures of intermediate output - services rendered. This type of information is available from the MSP. But services cannot simply be aggregated, since some services require more input of time and skill than others. The more common approach has been to use weighted service data to proxy activity levels, where the weights are prices (fees) (9,25,30,31). Of course the variants on this theme are endless. But one can distinguish a number of generic approaches to income-based fte estimation.

The process of estimating fte stock from income data is one of reducing one or more income frequency distributions to a scalar (or scalars) by applying a conversion algorithm to the distribution(s).

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4 These activity levels are used in determining future requirements, not current full-time-equivalent stock.

There are a number of problems, aside from the form of the algorithm. Restricting attention to fee practice billing will (by most fte definitions) result in an under-estimate of clinical stock. We have amalgamated salary, sessional and fee-for-service payments for each practitioner in the analyses which follow. Even this will exclude, for some physicians, a component of clinical income derived outside the MSP. This may include services covered by WCB, or uninsured services (such as cosmetic surgery). Since the latter are, by virtue of being uninsured, not considered essential health care services, and since the former will not appreciably alter any physician's full-time equivalence, we ignore these sources of income. Finally, the more basic problem of using income data to proxy activity levels remains (25). There are undoubtedly going to be practitioners counted as 1 fte who, by any 'time availability' approach, do not work full-time; and there will be others who do provide full-time clinical capacity but end up not counted at all by some fte definitions, and partially counted by others. One way of dealing with this problem is to combine billing pattern and pay amount information. But this gets one into other quagmires -- is a practitioner who works 12 hours a day, three quarters a year, any less (or more) a full-timer than one who works nine hours a day all year? Having committed all that to record, we proceed to look at some income-based approaches to fte stock estimation.

The simplest generic approach is application of a simple non-differentiated (SNOD) cutoff. This approach applies a single vertical spike to the income frequency distribution for all practitioners, counting each practitioner falling to the right of the spike as an fte, and excluding entirely each falling to the left. The choice of SNOD cutoff not surprisingly makes a considerable difference. A cutoff of \$30,000 reduces the 4,857 practitioners paid by MSP to just under 4,000 (3961). A cutoff of \$50,000 takes this down to 3543, while \$80,000 shrinks the fte stock to 2832.[5] Clearly there is a SNOD cutoff for every purpose.

One obvious problem with the SNOD approach is that it may ignore a lot of practitioners, at least parts of whom should be included in the fte count. Rectification of this problem gives rise to a second generic approach -- the augmented non-differentiated (AND) approach. Here we applied two alternative algorithms, CAND (continuous AND), and DAND (discontinuous AND). The CAND approach sets the full-time equivalence for each practitioner below the SNOD as $INC_i/SNOD$ (where INC_i is the MSP payments to the i^{th} practitioner); that is, each such practitioner's fte share was his/her MSP payments divided by the simple cutoff.[6] The DAND

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5 Recall that all of these figures exclude pathology and bacteriology, radiology, and medical microbiology.

6 For example, the MacDonald Report (9) uses an \$80,000 cutoff in a CAND approach.

approach uses the mean income of the SNOD-determined full-timers as a denominator, creating a discontinuity at the cutoff. That is, the full-time equivalence of each practitioner under the DAND approach is given by:

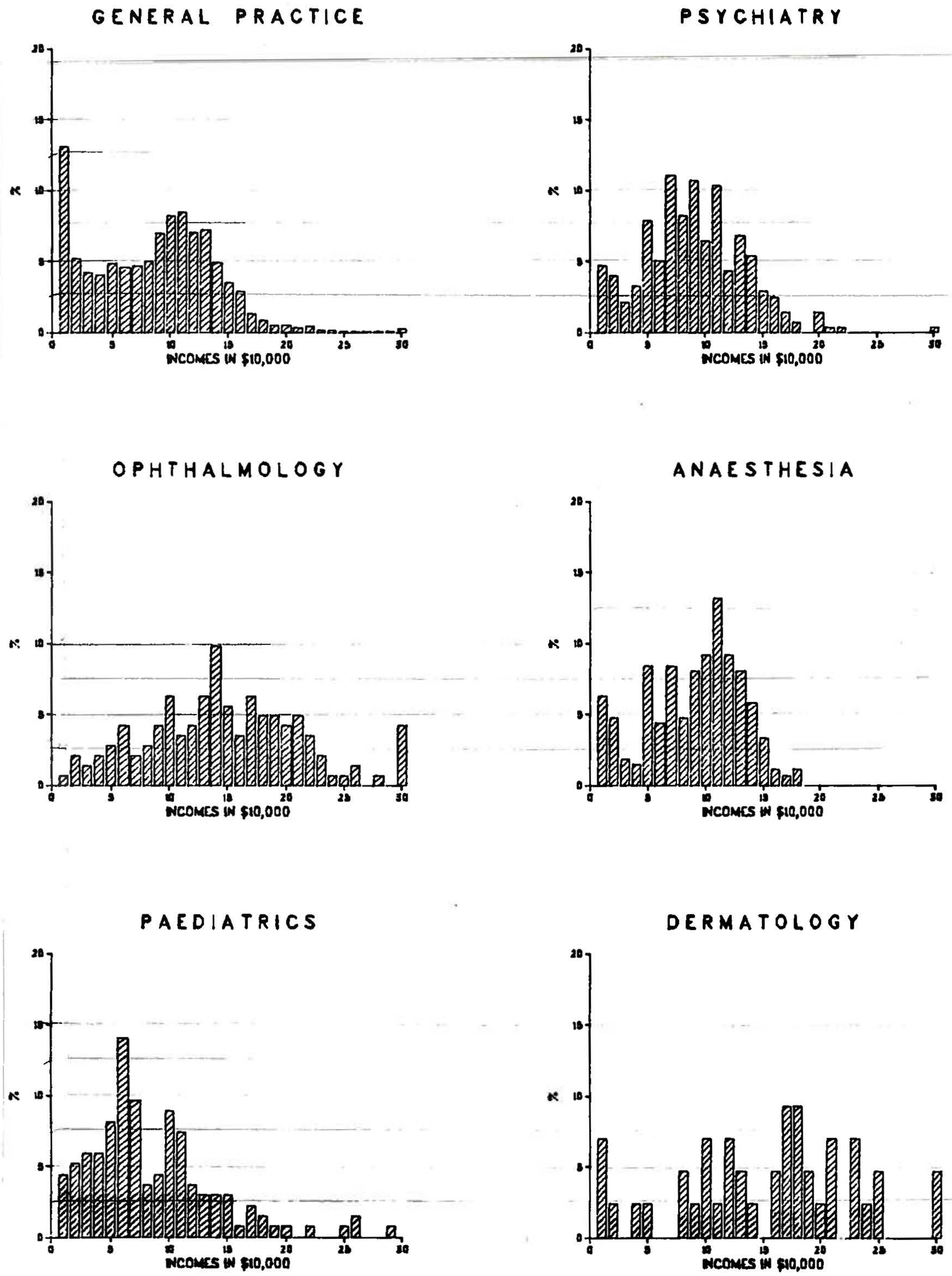
$$FTE_i = \begin{cases} 1 \quad \text{if } INC_i \geq SNOD \\ INC_i/MFTSNOD \quad \text{if } INC_i < SNOD \end{cases}$$

where MFTSNOD is the mean income of those practitioners paid at least to the level of the simple cutoff. Continuing with the $30,000 SNOD, the CAND approach yields 4,265 ftes, while the DAND approach naturally reduces this, to 4,043 ftes. Both approaches can be faulted, and some intermediate variant might better serve a particular purpose. If the SNOD cutoff is on the 'low' side, one might lean to the DAND approach, whereas a 'high' cutoff could more justifiably be incorporated in a CAND approach.

But there is a second, even more serious problem, not only with the SNOD cutoff but with its augmentation cousins. This problem is illustrated vividly in Figure 2. Recall that these approaches apply simple algorithms to the income distribution of all practitioners paid through the MSP. Figure 2 suggests that there is considerable inter-specialty variation in the shape of those distributions, and this is confirmed in Table 2 which reports the proportion of practitioners within each MSP type of practice who were paid at least $30,000 in 1981-82.

Of course there will always be some SNOD cutoff (or an augmentation variant to a lower SNOD cutoff) which will generate an fte supply figure

FIGURE 2: PAYMENT FREQUENCY DISTRIBUTIONS, SELECTED TYPES OF PRACTICE, B.C., FISCAL YEAR 1981-82



Note: The $300,000 bar represents incomes of $300,000 or more.

Table 2 PROPORTIONS OF PHYSICIANS WITH INCOMES[1] GREATER THAN $30,000.00

April 1981 to March 1982

Type of Practice	Proportion
Anaesthesia	0.872
Dermatology	0.907
Ear, Nose and Throat	0.882
General Practice	0.775
Internal Medicine	0.851
Neurology	0.833
Neurosurgery	0.920
Obstetrics & Gynaecology	0.885
Ophthalmology	0.958
Orthopaedic Surgery	0.919
Osteopathic	1.000
Paediatrics	0.844
Physical Medicine	0.706
Plastic Surgery	0.938
Psychiatry	0.893
Public Health	0.176
Surgery - General	0.858
Thoracic Surgery	1.000
Urology	0.914

[1] This includes all fee for service, salaried and sessional payments.

identical to that produced by application of any particular specialty differentiating algorithm. While some non-differentiated approach may therefore suffice for an aggregate count, it will (as shown in Table 2) create numerous specialty-specific problems. This suggests that for any purposes other than an aggregate count (and perhaps even then) a supply measurement algorithm based on incomes should build in specialty differentiation.

Specialty-specific fte estimation does not get us around the problem of choosing full time income 'cutoffs'. In fact, it multiplies the problem, necessitating multiple internally consistent cutoffs. Approaches are again of two generic types -- simple specialty-specific (SSS), and augmented specialty-specific (ASS). As with the non-differentiating approaches, the former involve ignoring everyone with payments below the cutoff, while the latter add those in. Here we describe three approaches, each of which may have simple and augmented variants.

In a background paper for the 1980 Hall Review, Wolfson et al. (25) denote a full-timer as any practitioner earning in excess of 50% of the median for the peer specialty. Of course one can then apply either continuous or discontinuous ASS options to pick up the 'part-timers'. This type of method has the advantage of creating inter-specialty consistency in the determination of cutoffs by taking into account differences in fee levels and 'normal' work patterns.

In Table 3 we show in column 2 the effective SSS cutoff levels for each type of practice implied by using the 50 per cent of median method. These figures illustrate rather dramatically the inter-specialty variation in the implied full-time cutoffs. Column 3 shows the numbers

Table 3

S P E C I A L T Y   S P E C I F I C   M E T H O D S   O F   E S T I M A T I N G   F T E 'S

April 1981 to March 1982

Type of Practice	Remunerated by MSPBC[1]	F T E[2]		F T E[3]	
		Payment cutoff	Number of FTEs	Payment cutoff	Number of FTEs
Anaesthesia	273	46,081.44	221	42,315.05	229
Dermatology	43	80,525.50	35	73,932.69	35
Ear, Nose and Throat	68	65,875.19	57	67,774.06	57
General Practice	2,890	43,452.34	2,070	40,521.57	2,119
Internal Medicine	335	51,663.44	255	57,115.30	243
Neurology	42	64,453.91	29	61,087.41	30
Neurosurgery	25	56,720.84	20	58,900.36	20
Obstetrics & Gynaecology	139	67,038.00	110	67,583.13	110
Ophthalmology	143	69,145.56	122	72,246.38	121
Orthopaedic Surgery	111	65,974.06	87	63,949.80	89
Osteopathic	4	40,012.34	3	47,796.87	3
Paediatrics	135	33,024.41	108	40,264.31	106
Physical Medicine	17	27,369.75	12	30,663.01	12
Plastic Surgery	32	61,112.13	30	61,034.01	30
Psychiatry	280	41,466.84	237	43,017.04	236
Public Health	17	5,883.60	17	9,818.75	13
Surgery - General	225	59,961.59	169	56,054.11	172
Thoracic Surgery	18	94,458.81	16	95,749.13	16
Urology	58	69,385.69	48	70,712.06	48
TOTAL	4,855		3,646		3,689

[1] This includes all fee for service, salaried and sessional payments.
[2] Each physician receiving payments of at least half the payment median for their peer type of practice is counted as 1 FTE.
[3] Each physician receiving payments of at least half the payment mean for their peer type of practice is counted as 1 FTE.

of ftes resulting from this SSS approach. The total of 3,646 is not surprisingly considerably lower than the SNOD or AND approaches based on a $30,000 cutoff, but closer to those based on $50,000. (It also turns out to be almost identical to the aggregate number of practitioners falling within the top three payment quartiles in each type of practice). When one applies the below-cutoff augmentation, a continuous approach increases the 3,646 to 4,113 and the discontinuous method described above yields 3,835 (about 200 less than the DAND approach using a $30,000 cutoff).

A similar method uses the mean rather than the median to set the full-time cutoff. Of course if incomes were distributed normally within each specialty this would produce identical estimates. As a comparison of columns 2 and 4 of Table 3 illustrates, in practice the general effect is minimal. For most types of practice, the mean is extremely close to the median, and the fte estimates are correspondingly comparable. There are a few interesting exceptions. Figure 2 showed almost 15 per cent of general practitioners having MSP income of $10,000 or less. This serves to pull the mean down below the median, and increase the fte stock estimate for general practitioners by about 2.5 per cent. On the other hand, a 'spike' at under $10,000 in internal medicine is counteracted by a flatter distribution of the rest of that specialty, and the mean-based cutoff ends up higher than that based on the median. The difference in the aggregate estimates is virtually entirely attributable to general practice. Again, augmentation variants of this SSS method may be applied. The fte estimates deriving from this method are 3,689 (SSS), 4,126 (continuous ASS) and 3,862 (discontinuous ASS). As one would expect, the continuous augmentation eliminates most of the difference between these two specialty-specific methods.

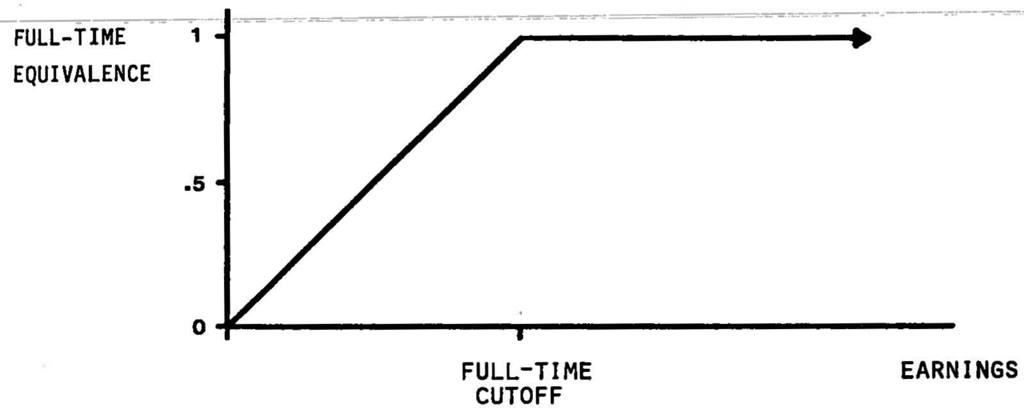
The final specialty-specific approach with which we wish to deal is that developed by Health and Welfare Canada, the so-called median-equivalence method. The details may be found in the appendix, but a number of summary comments seem in order. The method is of the ASS variety, with a few bells and whistles added. It focuses only on fee-for-service practitioners, drops a segment of very low earners before determining median earnings of the remainder, calculates a SSS cutoff equal to 90% of the resulting median, and then applies discontinuous step-augmentation. Figure 3 illustrates the three different treatments of the earners falling below the cutoffs determined by each method. The median-equivalence method generates an aggregate fte estimate for this time period of 3,679, about 4 per cent lower than the other two ASS approaches, and coincidentally virtually identical to the one-half-mean-earnings SSS method estimate. This difference, however, is not attributable to the method of augmentation as much as it is to the method of determining peer group full-time cutoffs. As noted in the appendix, this method applies proxy income levels to certain specialties with small number problems, and in general generates higher cutoffs (approximately 90% of an upward-adjusted median) than the other two methods.

Summary

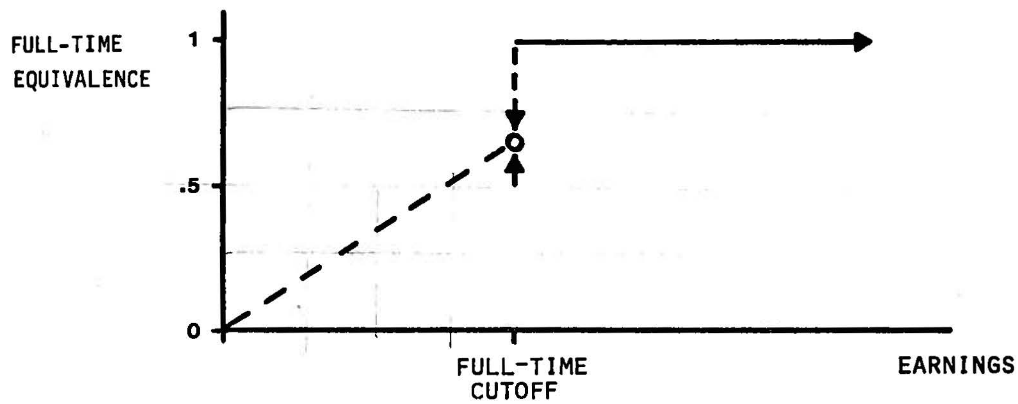
This section has reviewed a number of generic approaches to estimating fte physician stock. Table 4 provides a brief summary of the results of applying selected methods to the B.C. database for 1981-82.

FIGURE 3: SPECIALTY-SPECIFIC APPROACHES TO FTE AUGMENTATION FOR PRACTITIONERS BELOW FULL-TIME CUTOFF

A) CONTINUOUS AUGMENTATION



B) DISCONTINUOUS AUGMENTATION



C) MEDIAN-EQUIVALENCE AUGMENTATION

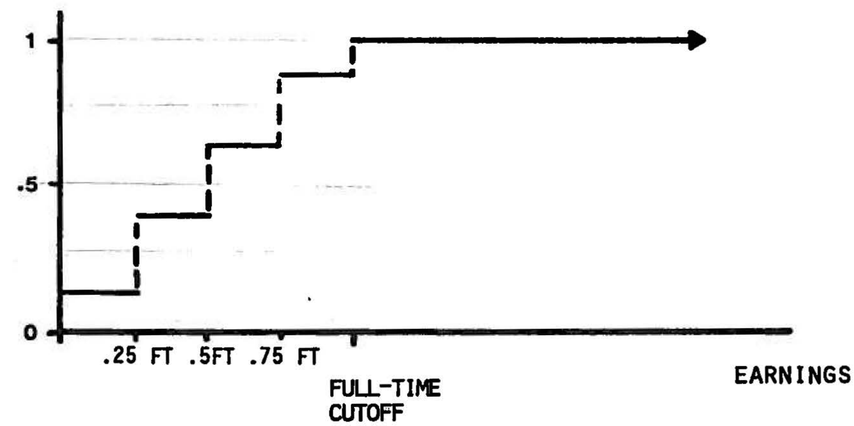


Table 4: Alternative Estimates of Physician Stock in B.C., 1981-82

CPSBC Directory Active[1]	7,094
CPSBC Directory Active in B.C.[1]	5,684
CPSBC Non-postgraduate Directory Active in B.C. or Postgraduate Paying Directory Active in B.C.[1]	5,306
Received some remuneration from MSP, fiscal year 1981-82[2]	4,857
Received at least $30,000 from MSP, fiscal year 1981-82[2]	3,961
Full-time-equivalents (DAND approach and a $30,000 cutoff)[2,3]	4,047
Number earning at least one-half median earnings in peer type of practice[2]	3,648
Full-time-equivalents (DASS approach and one-half median income cutoff)[2,3]	3,837
Number earning at least one-half mean earnings in peer type of practice[2]	3,691
Full-time-equivalents (DASS approach and one-half mean earnings cutoff)[2,3]	3,864
Median-equivalence method[2,4]	3,679

1 As at March 31, 1982

2 Not including practitioners with types of practice: pathology and bacteriology, medical microbiology, and radiology; includes fee-for-service salary and sessional pay

3 See text

4 See Appendix

Of course there is no basis from which to say that any particular figure in this table is "correct". One can confidently dismiss the first MSP-generated figure and the three CPSBC-generated figures as clear over-estimates of fte clinical stock. After that, all we have been able to illustrate is that the method does make a difference. It strikes us as intuitively unsatisfactory to exclude entirely those falling below some income cutoff -- that sort of discontinuity seems difficult to justify. The choice variables are, then, method of cutoff determination and method of below-cutoff augmentation. The methods described here produced a range of estimates from 3,648 to 4,115. Non-specialty differentiating methods may be satisfactory for the generation of aggregate counts, but create serious problems if one is interested in specialty-specific estimates.

To this point we have focused solely on the problem of estimating current stock, disaggregated to the level of specialty groups. In the next section, our attention turns to a new set of problems introduced by stock distribution questions.

IV. REFERRAL PATTERNS AND THE 'EFFECTIVE' DISTRIBUTION OF PHYSICIANS

The issue of geographic maldistribution of physicians very quickly gets one immersed in the problem of developing identification criteria for shortages (or surpluses). On the heels of that usually come the derivative problems of proxying under- (over) servicing by measures of morbidity and mortality, or even less satisfactorily by available medical care capacity (32,33). In this section we address two aspects of the latter problem. To continue our focus of the previous section on supply measurement, we first set aside the issue of physician stock measures as proxies for service requirements, and look at two alternative approaches to measuring clinical capacity at the regional level. Then we introduce what we feel is a more appropriate empirical approach to investigating maldistribution in servicing -- age/sex adjusted expenditures per capita. We close the section by examining very briefly the relationship between regional variance in this measure and in physician capacity.

Empirical research into the geographic distribution of physicians appears uniformly to be based on one of two possible conceptual approaches; that is that the appropriate way of viewing the distribution of physicians is in terms of physical location of the physicians (21,22,29). This seems clearly appropriate for investigations of, say, locational decision-making, or for the purposes of estimating health-related budgetary requirements on a regional basis. But if one is interested in examining physician distribution for purposes of assessing access to medical services, or as we are here in estimating effective clinical capacity, a more appropriate method of measurement should take into account inter-regional sharing of clinical capacity.

Of course appropriateness in this context is solidly rooted in normative assumptions about desirable distributions. If one happens to believe that, irrespective of service needs, each specialty should be evenly distributed across regions, then 'counting them where they lie' is appropriate. If, instead, one shares our view that many specialties require complementary, specialized technology and need critical population masses to justify their existence (that is, that there are legitimate reasons for 'maldistribution'), then an even distribution becomes significantly less desirable. But once one moves away from an objective of even distribution, inter-regional physician/population ratio comparisons based on physical location become misleading. They amount to basing a distribution comparison on a measure of stock in which the numerator and denominator are incompatible. That is, if the intent of a physician/population ratio is to reflect the physician capacity available to a particular segment of the population, and if the numerator is based on the geographic location of the population in the denominator, it may under-or over-estimate effective capacity available to that population.

Regional FTE Distribution Revisited

In an attempt to assess the effects on apparent distribution of this conceptual approach to measuring regional stock, we computed ftes per capita for each type of practice in two ways. The first was based on allocating each practitioner to the regional hospital district (RHD) containing his/her office address. The second used MSP pay records and attempted to allocate 'pieces' of each physician to the RHDs of his/her serviced patient population. Since MSP has accurate patient address information on only about one-half of the province's subscribers, the

RHD of the referring physician was used as a proxy for patient location.[7] Where there was no referral, the RHD of the attending physician was used to proxy the RHD of the patient.

Because no similarly clever way of allocating salaried and sessional payments across RHDs came to mind (patients are not identified), this segment of the analysis was restricted to fee-for-service payments in the fiscal year.

The RHD of each physician was determined by comparing RHDs of record at the beginning and end of the period of analysis. If they were identical, that became the physician's designated RHD. If a practitioner was outside the province at one end-point, the RHD at the other was adopted. If a physician happened to be out-of-province at both end-points, but billed the MSP during the fiscal year, monthly CPSBC records were scanned and the most recent RHD of record was adopted. Finally, where there were two different RHDs at the end-points, the date of address change was determined, and the physician's physical location was pro-rated accordingly (30).

The method of fte allocation to the RHDs of patients consisted of two stages. First, the proportions of each practitioner's payments

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7 This may be inappropriate in the case of contiguous RHDs; where a treatment chain involves one or more subsequent referrals by practitioners in RHDs different from that of the original referring physician; or where a physician actually renders service in RHDs other than his/her designated RHD (30). The first and last of these phenomena may also affect the reliability of using attending physician in cases of no referral.

made on behalf of patients from each RHD were determined. The MSP Statistics Master File (or most of it) was passed, record by record, and the information on attending physician, referring physician (if any) and amount paid was used in conjunction with physician location information from the CPSBC Medical Directory database to derive these proportions. The second stage amounted to applying the proportions for each physician to his/her full-time-equivalence count, and allocating the resulting fte's back to the RHDs. Finally, the fte counts were aggregated for each specialty and region.

This method was applied to the entire set of fte definitions described in the previous section, and the complete set of results is available elsewhere (30). Here we provide a selective set of results sufficient to illustrate the differences in the two approaches. We retain a single fte estimation approach throughout, that being the "one-half-mean income cutoff DASS approach" (full-time cutoff of one-half the mean payments within each type of practice, augmented using the discontinuous method: payments divided by mean payments to the full-timers, for those below the cutoff).

Figure 4 compares graphically the geographic distributions based on location of physician and on estimated location of patients, for three broad aggregations -- general practice, clinical specialties and surgical specialties.[8] Since most services provided by general practitioners are non-referred, it is not surprising that the allocation process has little effect on general practice distribution. The effect is somewhat more obvious for the clinical specialties. In

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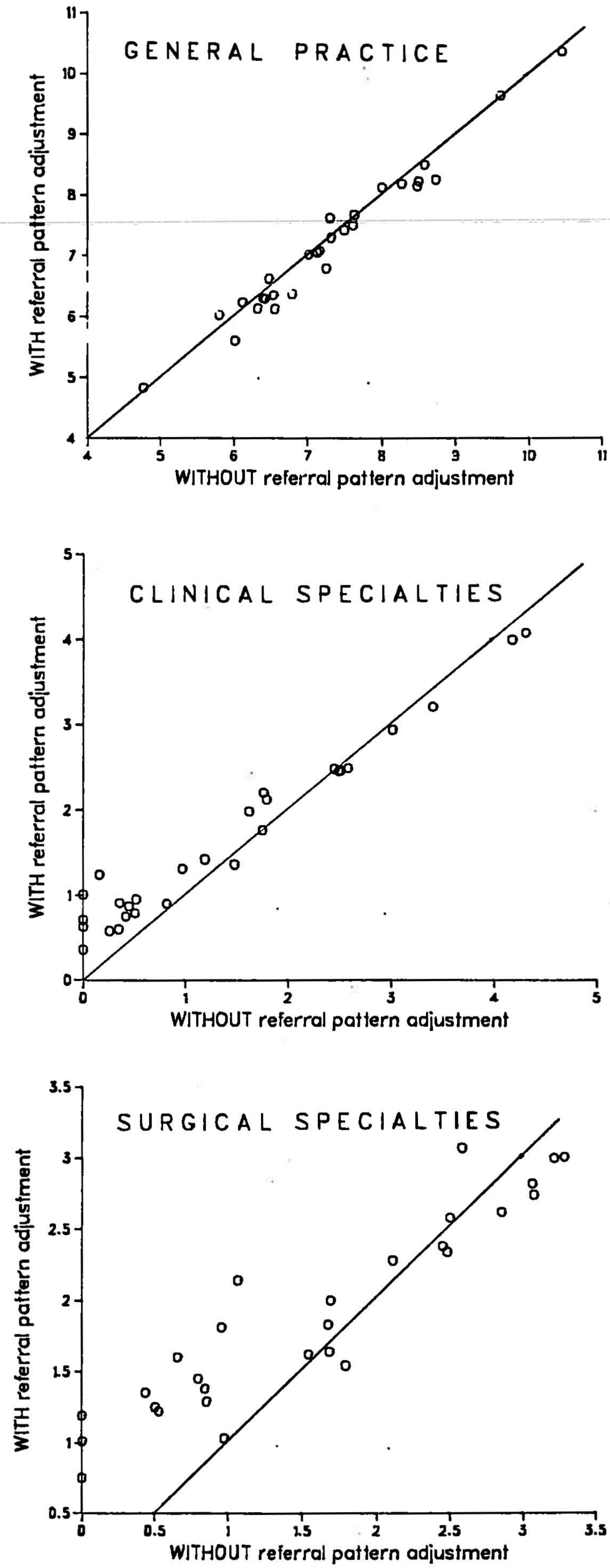
8 See (34) for the Specialties falling within each of 'clinical' and 'surgical'.

FIGURE 4: REGIONAL DISTRIBUTION OF FTES PER 10,000 POPULATION, PATIENT LOCATION VS PRACTITIONER LOCATION



particular, one notes an intercept of approximately 0.5 ftes per 10,000 population, indicating that regions with low physical supply are net recipients of about that capacity equivalence. Four regions with no practitioners show ranges of about 0.3 to 1.0 per 10,000 after the adjustment for referral capacity. But the impact is most dramatic for the surgical specialties, where the distribution changes markedly as a result of the adjustment, with the low physical supply regions picking up effective capacity, and vice versa.

As a second approach to assessing the impact of the referral pattern adjustment, we regressed fte's per capita after adjustment on fte's per capita without adjustment, for each type of practice. We were able to reject the null hypotheses ($p<0.05$) that the adjustment makes no difference (H_o: slope=1) for every type of practice except general practitioners and (marginally) anaesthesia.

Finally, we narrowed our focus to the so-called non-metropolitan RHDs (all but Greater Vancouver and Capital Regions, the latter containing the second largest city, Victoria), and computed coefficients of variation in fte's per capita using the same fte approach with and without referral pattern stock allocation. The results appear in Table 5, and are generally consistent with those from the regression analyses (which were based on all RHDs). The coefficients of variation are left relatively unchanged for anaesthesia and general practice, but show dramatic declines for all other types of practice. Particularly noteworthy is the effect of adjusting for referral care patterns of neurologists, neurosurgeons and thoracic surgeons.

These results taken collectively suggest that for purposes of measuring available or effective clinical capacity, fte per capita

Table 5

C O E F F I C I E N T S O F V A R I A T I O N

across Non-Metropolitan Regional Hospital Districts

by Type of Practice and by Referral Adjustment

for Full-Time Equivalent Definition DASS

Type of Practice	RHD of Servicing Physician	RHD of Referring Physician[1]
Anaesthesia	96.8	93.8
Dermatology	194.3	80.6
Ear, Nose & Throat	133.0	43.9
General Practice	24.7	24.4
Internal Medicine	89.5	49.0
Neurology	251.1	65.9
Neurosurgery	354.5	85.2
Obstetrics & Gynaecology	85.4	45.7
Ophthalmology	101.1	77.2
Orthopaedic Surgery	110.2	44.9
Osteopathic	459.0	459.0
Paediatrics	114.3	58.8
Physical Medicine	382.0	219.7
Plastic Surgery	263.4	109.0
Psychiatry	115.5	81.7
Surgery - General	62.4	46.1
Thoracic Surgery	509.9	127.2
Urology	133.9	55.3

[1] The RHD used is that of the referring physician when available; otherwise, the RHD is that of the servicing physician.

estimates based on inconsistent numerators and denominators tend to bias upward the apparent extent of 'maldistribution'. Even without regard to the appropriateness of these measures as maldistribution indicators, the potential clearly exists to use inappropriately constructed distribution indices to support a case for geographic re-allocation policies. But as we noted earlier, the more basic issue is the construction of valid measures for assessing claims of maldistribution, whether of under- or over-servicing.

Per Capita Expenditures or FTEs per Capita

Ginzberg (35, p.210) succinctly captured the essence of what we are attempting to portray empirically, in his recent statement that "in an unequal society with differentials in income, all resources will be differentially distributed ... an uneven distribution does not mean that [city of your choice] has a geographic shortage of physicians". While age-sex adjusted expenditures per capita may still be some distance from a valid measure of regional disparity in access or need-servicing capacity, it strikes us as being a significant conceptual improvement over actual physical practitioner capacity. Of course the practical improvement will be attenuated to the extent that physical capacity generates expenditures. We close this section by comparing one measure of disparity for ftes per capita and expenditures per capita.

But first we examined the effect on age-sex adjusted per capita expenditures of adjusting for cross-regional servicing. In this case we needed only to allocate actual fee payments to each practitioner back to the (proxied) RHDs of the patient mix and then to aggregate payments by type of practice and patient age-sex category within each RHD. The resulting fee-for-service expenditure totals for each type of practice were age-sex standardized (to the provincial population proportions), and then divided by the RHD's total population. These regional expenditure summaries were then subjected to the same three types of inferential analysis as was described above for the adjusted vs unadjusted ftes per capita.

In Figure 5, we have arbitrarily selected three types of practice which most dramatically portray the differences in payments per capita with and without the cross-regional servicing adjustment. The first chart, for general practice, is provided as the example of the type of practice for which the adjustment is essentially unnecessary. The graph for anaesthesia (not included here) looks much the same. The second graph, for orthopaedic surgeons, exemplifies a number of the clinical and surgical specialty patterns, and shows rather vividly the clustering effect of the adjustment process. Finally, we include the figure for pathology and bacteriology which, along with radiology and nuclear medicine defied fte analysis because of the earlier-noted peculiarities in payment arrangements. It seems clear that these specialties are the most dramatically affected by adjusting for inter-regional servicing.

The next stage was type of practice-specific simple regression of age/sex adjusted expenditures per capita with adjustment, on the same without adjustment. In this instance we could reject the null hypothesis ($p<0.05$) for all but general practice, with anaesthesia now barely exceeding the critical t-level. The results appear as Table 6. The intercepts may be interpreted as average type-of-practice-specific fee for service expenditure per capita on behalf of residents of RHDs physically without any practitioners of each type. This ranged from under twenty five cents per capita for general practice (provincial

FIGURE 5: AGE-SEX ADJUSTED FEE-FOR-SERVICE PAYMENTS PER CAPITA BY REGION, PATIENT LOCATION VS PRACTITIONER LOCATION

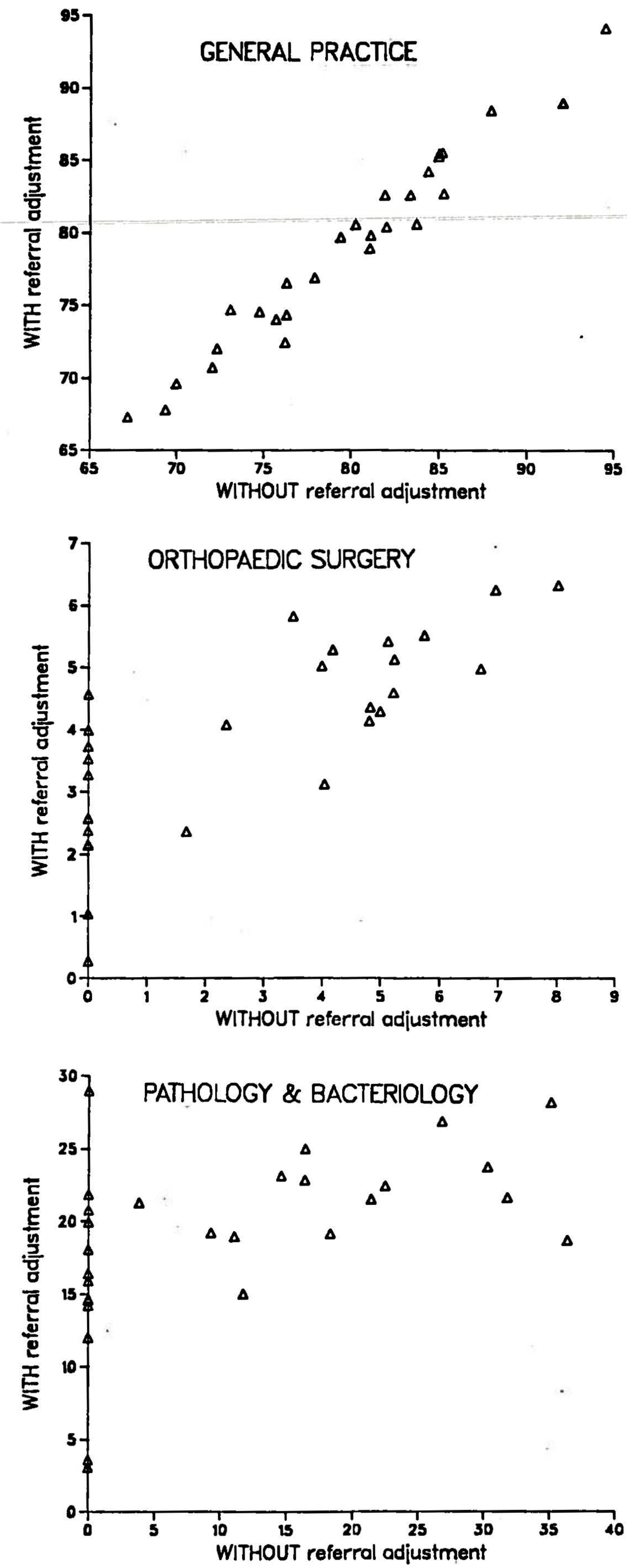


Table 6

SIMPLE REGRESSIONS OF AGE/SEX EXPENDITURES PER CAPITA

without Referral Pattern Adjustment vs. with Referral Pattern Adjustment

by Type of Practice and Regression Coefficients and Statistics

Type of Practice	Intercept	Slope	95% Confidence Interval		T-statistic[1]		R Squared
			Lower	Upper	Calculated	Significance	
Anaesthesia	0.116	0.983	0.965	1.000	2.102	**	0.998
Dermatology	0.670	0.493	0.343	0.643	6.920	***	0.627
Ear, Nose & Throat	2.116	0.344	0.168	0.521	7.624	***	0.373
General Practice	0.201	0.987	0.954	1.020	0.808	*	0.993
Internal Medicine	5.232	0.584	0.485	0.684	8.554	***	0.843
Neurology	0.747	0.530	0.396	0.664	7.196	***	0.709
Neurosurgery	0.563	0.507	0.334	0.681	5.815	***	0.571
Obstetrics & Gynaecology	2.584	0.586	0.505	0.667	10.501	***	0.891
Ophthalmology	1.644	0.764	0.659	0.870	4.583	***	0.891
Orthopaedic Surgery	2.775	0.418	0.277	0.560	8.449	***	0.577
Paediatrics	1.111	0.690	0.591	0.789	6.418	***	0.883
Physical Medicine	0.093	0.701	0.608	0.794	6.621	**	0.916
Plastic Surgery	0.433	0.666	0.552	0.780	6.010	***	0.841
Psychiatry	0.777	0.837	0.748	0.926	3.760	***	0.932
Surgery - General	3.035	0.736	0.628	0.843	5.047	***	0.880
Thoracic Surgery	0.270	0.743	0.608	0.877	3.938	***	0.841
Urology	1.423	0.474	0.360	0.589	9.408	***	0.727
Radiology & Nuclear Med.	7.368	0.447	0.329	0.565	9.623	***	0.691
Pathology & Bacteriology	16.001	0.257	0.088	0.426	9.022	***	0.265

[1] A two-tailed test of the hypothesis that the slope = 1.
*   denotes a significance level greater than 0.05.
** denotes a significance level less than 0.05 but greater than 0.01.
*** denotes a significance level less than 0.01.

average expenditure of $82), anaesthesia and physical medicine, to $16 per capita for pathology and bacteriology, where the provincial average expenditure was slightly more than $22 (30).

Finally, we focused once again on inter-regional disparity outside the two metropolitan RHDs and computed coefficients of variation before and after the cross-regional servicing adjustment. The story in Table 7 is quite similar to that in Table 5, but there are a few noteworthy points. The first deals with the two types of practice not included in Table 5 -- radiology and pathology. The reduction in the coefficient is pronounced for both, but particularly dramatic for the latter, where a variance in excess of the mean is reduced to becoming one of the three lowest coefficients among the nineteen types of practice. The second point worth noting is that in thirteen of the seventeen types of practice appearing in both tables, the per capita expenditure results show a more dramatic reduction in distributional variance than do the fte results. The only exceptions to that trend are anaesthesia, general practice, neurosurgery and paediatrics, and in all cases the differences are minute. On the other hand, the most dramatic difference appears for thoracic surgery (a 50 per cent reduction in the with-adjustment coefficient as we move from Table 5 to Table 7).

Summary

The purposes of this section were twofold. First we examined the empirical effects of two perspectives on measuring fte regional distribution, and found that allocating practitioners to the estimated RHDs of their patients changes the distributional picture rather dramatically for many types of practice.

Table 7

COEFFICIENTS OF VARIATION
in Age/Sex Adjusted Expenditures per Capita
across Non-Metropolitan Regional Hospital Districts
by Type of Practice by Referral Pattern Adjustment

Type of Practice	RHD of Servicing Physician	RHD of Referring Physician[1]
Anaesthesia	107.3	104.2
Dermatology	197.9	69.2
Ear, Nose & Throat	137.4	45.1
General Practice	20.5	20.4
Internal Medicine	82.1	36.4
Neurology	240.6	59.0
Neurosurgery	366.5	89.9
Obstetrics & Gynaecology	81.5	39.0
Ophthalmology	100.3	68.5
Orthopaedic Surgery	107.5	38.5
Paediatrics	126.9	67.2
Physical Medicine	372.5	210.6
Plastic Surgery	243.7	91.1
Psychiatry	115.3	78.7
Surgery - General	60.1	41.4
Thoracic Surgery	509.9	81.5
Urology	150.6	55.0
Radiology & Nuclear Medicine	63.6	30.0
Pathology & Bacteriology	118.8	32.5

[1] The RHD used is that of the referring physician when available; otherwise, the RHD is that of the servicing physician.

The second focus of this section was on an alternative (to fte capacity per capita) approach to developing an informational base for inter-regional servicing requirements analysis. We suggested that age-sex adjusted expenditure per capita provides a step in conceptual improvement. Some empirical investigations both of the effect of allocating the expenditures to the patients rather than the physicians, and of the apparent differences in regional maldistribution revealed by the fte and expenditure per capita distributions respectively, were presented.

While variation in expenditures per capita seems slightly less than variation in ftes per capita for most types of practice, two factors weigh against us having found more marked differences. First, our fte counts are definitionally based on expenditures. It would be surprising indeed to find too-dramatic differences. Second, if capacity generates its own fee-for-service expenditures, again one would be hard-pressed to explain large differences.

V. REFLECTIONS AND POLICY IMPLICATIONS

This paper began with the two apparently simple objectives of investigating empirically (i) alternative approaches to the measurement of current physician stock, and (ii) the impact of viewing effective physician distribution from a patient rather than provider perspective. Along the way we developed a definitional framework within which to set into context the many potential approaches to measuring stock.

Since each empirical section has its own summary, we restrict our comments here to general reflections which derive both from having undertaken these analyses and from the results. A first point would seem to be that there truly is a method of measuring supply for every purpose, and it is that very fact that should lurk behind interpretations of any published or public pronouncements relating either to physician stock or average physician incomes. Using two different databases for the (approximate) same time period, we were able to generate 'stock' estimates with a two-and-one-half-fold range (2,800 to 7,000). Even applying various approaches to a single (MSP) database generated a considerable (almost twofold) range in estimates. While the more 'reasonable' estimates tended to cluster, a ten per cent variance remained. Ultimately one must go beyond developing a short list of approaches appropriate to the question, to explicitly choose either a range, or a point estimate based on some collection of more-or-less supportable assumptions.

The second point relates to the issue of geographic mal-distribution. Debate over this issue seems as much muddied by lack of effort to formalize normative assumptions, as by empirical variation. A distributional criterion of identical physical numbers per capita within some pre-determined regional boundaries is but one of an endless variety of possible criteria. It also happens to be a criterion with which we have considerable difficulty. Even within that criterion, the problem of determining the appropriate regionally-invariant stock levels remains, but the 'levels' problem is exacerbated in the more realistic regional variation scenarios which take cognizance of critical population mass, the value of critical intellectual mass, and the complementary role (and cost) of medical technology.

The normative and empirical problems are of course intimately intermingled. Attempts to answer questions such as "do we have a geographic distribution problem for anaesthetic services in B.C.?" require, first, distributional criteria against which to compare current patterns and, second, reasonable and consistent methods of measuring those patterns. The normative base will be necessary although not sufficient for the derivation of both.

Our focus in Section IV was empirical. After arguing against the 'identical numbers' criterion, we looked at the impact on apparent distribution of services and practitioners, of viewing both from a patient 'accrual' rather than physical practitioner perspective. We found significant differences in effective distribution when the numerators and denominators of expenditures per capita and physician stock per capita were made internally consistent. To say that physicians residing in Greater Vancouver represent the effective available capacity for residents of that RHD is simply wrong. Clearly a significant segment of their productive capacity is a provincial resource. Failure to incorporate that reality seems a sure way to generate misleading and costly policy.

The most obvious extension of these analyses would appear to be to use the results in causally investigating regional variance in age-sex adjusted expenditures per capita. This research has provided not only the dependent variables, but also a wide variety of approaches and results for one of the key independent variables -- full time equivalent practitioner stock and mix. In addition the data base developed for this research will permit detailed investigations of inter-specialty and inter-regional referral networks, patient care-seeking patterns, utilization effects of internal fee schedule changes, and so on. The usual binding constraints apply.

APPENDIX

Full-Time Physician Equivalents
MEDIAN Equivalence Method

This is a summary of the steps that need to be taken to calculate the number of full-time physician equivalents by the Median Equivalence method. The time-frame of the data used is the fiscal year. A physician who had more than one specialty during a year is assigned the one in which he received most of his payments.

Listed below are the steps to be taken in sequence:

(A) For a given specialty, identify all fee-for-service physicians to whom the medical plan made at least a single payment over the course of the year.

(B) Arrange in rank-order of their earnings the physicians as identified in (A) and determine the median earnings of the specialty, i.e. Median 1.

(C) From the physicians in (A), remove those physicians whose earnings are less than 2% of Median 1 or less than $1,000, whichever is higher, and then determine the new median earnings for the remaining physicians, i.e. Median 2.

(D) Obtain Median 2A which is equal to 90% of Median 2.

(E) Assign the weight 1.000 to each of those physicians whose earnings are larger than or equal to Median 2A, and obtain the subtotal of all 1.000s.

(F) Assign the weight 0.875 to each of those physicians whose earnings are less than Median 2A but larger than or equal to 75% of Median 2A, and obtain the subtotal of all 0.875s.

(G) Assign the weight 0.625 to each of those physicians whose earnings are less than 75% of Median 2A but larger than or equal to 50% of Median 2A, and obtain the subtotal of all 0.625s.

(H) Assign the weight 0.375 to each of those physicians whose earnings are less than 50% of Median 2A but larger than or equal to 25% of Median 2A, and obtain the subtotal of all 0.375s.

(I) Assign the weight 0.125 to all of those physicians whose earnings are less than 25% of Median 2A, and obtain the subtotal of all 0.125s.

(J) For the total number of full-time physician equivalents for the specialty, add together the subtotals in (E) through (I).

(K) For each of the remaining specialties, repeat the steps (A) through (J).

(L) Add together the results from (J) and (K) to get the total number of full-time physician equivalents for all specialties.

For certain specialties, the median earnings are rather sensitive to the sample size so that their stability from year to year is less than acceptable. Also, the specialty Psychiatry in certain provinces tends to have a larger number of low-earning physicians than other specialties, which brings down its median earnings to the level which in all probability cannot be regarded as commensurate with those of an average full-time psychiatrist. These difficulties are overcome, when calculating full-time physician equivalents, by using the Median 2 of Internal Medicine for Neuropsychiatry, Psychiatry, Neurology, Dermatology, Physical Medicine and Public Health; by using the Median 2 of General Surgery for Thoracic-Cardio-vascular Surgery, Plastic Surgery and Neuro-surgery; and by using the Median 2 of Ophthalmology for Otolaryngology/Ophthalmology.

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