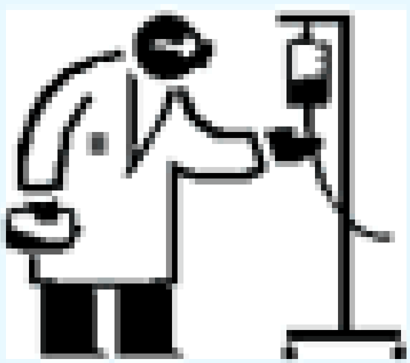
A PHYSICIAN WORKFORCE PLANNING MODEL FOR THE SPECIALTY OF ANESTHESIA:

THEORETICAL AND PRACTICAL CONSIDERATIONS



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- Anesthetists required for clinical service
- Anesthetists required for non-clinical service
- Age/sex differences in workloads

A "Best" Estimate of Demand for Anesthetists in the Year 2016

8) Future Supply

- Trends in Number of Anesthetists, 1986-1999
- How Accurate are the Annual Stock Counts of Anesthetists?
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1) What is a Planning Model?

In the field of health care in Canada, physician workforce planning is a very popular activity. Everybody seems to be engaged in it. A variety of ad hoc methodologies are used, some of which are described as planning models. What does or does not qualify as a planning model is rarely, if ever, a consideration. In this study the term planning model is used to describe a particular type of methodology and processes for planning. This methodology and accompanying procedures are defined in this opening section.

Both of the words "planning" and "model" are well understood in their common everyday usage. Yet their combination into a single expression is a different matter altogether. To get at an understanding of the technical definition of a planning model, let us start with some dictionary definitions of the two words in question.

> *Plan: to devise, design something to be done, or some action, etc. to be carried out; to arrange beforehand*
>
> *Model: to present as in an outline; to produce in clay, wax or the like a figure or imitation of anything; something that accurately resembles something else.*
>
> Oxford English Dictionary

When we combine these definitions of the everyday usage of the words in question, we arrive at the essence of what a planning model entails. We construct a model of how a system works in order to plan some action designed to reach a future goal. Of course, when constructing a model for planning the physician workforce, we do not use clay or wax, but rather what we construct is a mathematical model that is intended to express the numerical determinants of the number of physicians at a given point in time. We do not construct such models for the intellectual pleasure of the exercise. Rather, we think that working with a planning model constitutes a more rational way of deciding how many physicians should be practicing and how many should be educated than looking at tea leaves or basing decisions on purely political expedience. If we keep in mind that the term *planning model* is a shortcut for saying a *model for planning*, the goal directed aspect of the activity is more readily apparent.

The set of procedures and phases of production of a model for planning can be more formally set out as follows:

1. Formulation of a problem or problems
2. Construction of a mathematical model to represent the system(s) under study
3. Derivation of a solution or a set of solutions based on working with the model
4. Testing the model and the solution(s) derived from it
5. Implementation of solutions
6. Feedback from developments in the real world (by comparing projections with actual developments and also feedback from the implementation of solutions. Feedback is essential to modify solutions in the light of empirical experience.

It is very important to note that all phases listed above, some of which may be engaged in concurrently, are part of the process. It is not sufficient to carry out a study and reach some conclusions, which may or may not have policy implications. Because circumstances change with the passage of time, a complete modeling and planning process must include testing and feedback. In short, the planning process is not a one-shot affair but rather consists in continuous study, learning, updating and revision.

2) Of What Use Is A Planning Model And How Should It Be Used?

Devising a planning model forces one to think clearly and carefully about a given problem or process. First of all a decision must be taken as to which elements should be included. It soon becomes apparent that social processes are very complex indeed and that everything relevant and important cannot be quantified. As only quantifiable elements (these elements will be referred to as variables from now onwards to make clear that only quantifiable items figure in the actual model) can be used, it is particularly important to find and include variables that accurately model the complex processes under study. If the variables chosen or the numerical values given to the variables in the model do not capture reality sufficiently accurately, no credible projections into the future are possible.

Without credible projections sensible planning policies cannot be formulated and hence the wrong decisions are likely to be taken. To use a simple analogy, if the wrong diagnosis is made, the remedy proposed is unlikely to cure the disease and may make things worse.

Because it is impossible to predict what will happen in the future, any scenarios about what the future holds derived from calculations from a model must be considered tentative. The work that goes into a model may be of excellent quality or of very poor quality, the fact remains that, at best, any projections based on quantified relationships are a set of "if" statements. Examples:

- If immigration levels are 100,000 per year, then ....
- If medical schools admit 2000 students per year, then ....
- If 5% of medical school graduates do not practice medicine at all, then
- If utilization of health care services remains the same in the future as it is today, then .....
- If 50% of medical school graduates are women, then ....
- If there is a nursing shortage, then ....
- If 5% of medical graduates choose anesthesiology as their field of practice, then ....
- etc., etc., etc.

The number of "if" statements that could be formulated tends towards infinity and no study could possibly include (i.e., numerically quantify) more than a small proportion of the theoretical total. If all the "ifs" were equally important or significant in determining outcomes, there would be no point in doing this kind of work at all. What is required is a judicious selection of a finite number of quantifiable variables, for which good data are available. This will produce useful results *as long as the work does not cease after the first iteration*.

This is where ongoing study and feedback become important. Let us take as an example population data, because population data are a central feature of all workforce studies. The number of people resident in Canada changes all the time, and figuring out the number of persons for whom health care services must be provided in the future is necessarily a part of any planning exercise. Let us assume that government has adopted a policy of permitting the entry into Canada of 100,000 immigrants a year and let us further assume that the planning model has used population projections based on an immigration level of 100,000 per year. Let us next assume that 2 or 3 years after the work has commenced, government now adopts an immigration target of 200,000 per year. A properly working model will now be adjusted to reflect the new numerical values for population based on revised immigration figures. The new calculations will result in changed estimates of requirements at the target date, which, in turn, should feed back into decisions as to how to reach planning goals. Regular checking of the coefficients (a coefficient is the numerical value taken by any variable included in a study) should apply to all the variables used in the model. This is one aspect of testing the model. Only through testing can questions such as the following be answered: Does the model accurately represent the real world? To what extent, and how rapidly, are projections derived from the model deviating from real world developments? Are these differences in real world developments due to poor modelling or to unpredictable changes that could not have been anticipated at the first iteration of the model (such as changes in immigration policies)? The follow up work to the development and implementation of the model must be able to figure out whether the model is a good one (i.e., it is a fair representation of reality), whether the initial measurements of the included variables were accurate or not, the aim being to alter the model if it does not represent reality sufficiently and to adjust the coefficients of the variables used as better information becomes available. That is how a model is supposed to work and how it should be used.

If a physician workforce study is carried out but no testing of the model takes place thereafter or no retrospective checking or updating takes place, no matter how good the initial study, it is not a planning model. It is, perhaps, the first stage of the complete process. Such occasional studies are not without importance, and may be essential, but they are not sufficient, as they are bound to become rapidly outdated as the real world goes its own way without reference to what any social scientist has “predicted” or “forecast”. Those who doubt this should ask themselves how Canada came to create for itself a major physician shortage at a time when thousands of qualified applicants were refused admission to medical school year after year.

Having dwelled some time on what a planning model is, it is time to say a few words about what it is not.

We are so used to hearing the results of workforce studies reported as, “it is forecast that in 10 years there will be too many doctors” or “new study predicts nursing shortage” that it is easy to forget that workforce studies are **not** merely about predicting the future. Manpower studies are akin neither to weather forecasting nor to astrology. The test of the quality of a physician workforce study is not whether it predicts the future accurately. The test is whether using a planning model enables us to rationally **shape the future**. Of course, if the model itself is poor or the measurements used in it are poor, the projections that form a central role in the model cannot possibly be accurate. Stated simply, the model tells us that under a certain set of circumstances (the “if” statements), **without intervention**, the future is predicted to turn out a particular way. Whereas every effort must be made to produce accurate projections, knowing how the future is going to turn out if no intervention takes place, is not the final purpose of the exercise. **The goal is to decide what we would like the future to be and to take the necessary steps to avoid a future we don’t want and to replace it with one we do want**. Accurate, regularly up-dated projections are an essential tool in reaching this goal. That is the use to which modelling should be put.

3) Why Plan the Anesthesiology Workforce?

The full spectrum of knowledge and therapeutic techniques in medicine is so vast that it is quite beyond the capacity of any single individual to master the entire domain of medicine. For several decades there has been an accelerating trend towards specialization in medicine, a trend that shows no sign whatsoever of abating. As the body of knowledge in a field grows, so does the pressure for a new specialty or sub-specialty to be recognized. At the present time there are xxx specialties and sub-specialties that are formally recognized in Canada, as well as many areas of concentration that are not yet sanctioned through specific qualifications. Although there is some overlap in what different types of physicians do, in general, specialists stick to activities in the domain of their specialty. For example, it is quite unthinkable that a physician trained as a psychiatrist would perform cardiac surgery.

Some specialties cater to specific segments of the population. Pediatricians deal with a young patient load; geriatricians with the elderly. Obstetricians have females in a restricted age group as their patients.

Because different specialties serve different segments of the Canadian population, or different segments of the population use particular specialties' services at a different rate, and because physicians trained in one specialty are either not substitutable at all for physicians trained in another specialty or substitutable only to a very limited extent, it is necessary to study the demand for and supply of physicians in each specialty. In short, it isn't good enough to figure out how many doctors we need, we need to figure out how many of each kind also.

Physician workforce planning that is based on an assumption of a uniform rate of growth in demand for physician services across all age groups, both sexes and all branches of medicine is starting out with a fundamentally erroneous assumption.

When the population is ageing rapidly, as is Canada's population, the demand for services utilized by the elderly will grow faster than the demand for services utilized by younger segments of the population. This is even more of a consideration when birth rates are low, as they are in Canada, and the youngest age cohorts, which consume relatively few health care services per capita, are not increasing in size very much or, in some cases decreasing in numbers. There is no reason whatsoever why we should plan to increase or decrease all types of physicians at the same rate. It follows from this that if the physician workforce is to be planned at all, it is desirable to engage in specialty specific planning.

If a planning methodology is to be specialty specific, it must include variables and statistical data that focus on the specific professional/medical services delivered by that specialty. A means must be found of measuring what members of that specialty do and of estimating future requirements for the services that comprise the specific expertise of the specialty.

To the extent that the expertise of the specialty is unique to it, (i.e., little substitution is possible), it is desirable that the needs related to that specialty be the subject of individual study.

Anesthesiology is a highly specific specialty. Few physicians who are not qualified as anesthetists will ever administer anesthetics to patients. Even GP anesthetists practicing in rural or remote areas have extra training before they take on the extra tasks of providing anesthesia. Anesthesiology is a comparatively large specialty. It has a well-developed field of expertise unique to it. It serves people of all ages, but not at the same rate. It is indispensable to the delivery of surgical services and hence, ensuring an adequate supply of anesthetists is an essential condition for the adequate delivery of surgical services. Thus, the specialty of anesthesiology meets all the conditions that make it a fitting candidate for pioneering in the development of specialty specific planning models.

However, planning for individual specialties cannot ignore broader physician workforce issues. No specialty functions in isolation as each fits into a health care system that includes many types of physicians and other health care professionals. No planning can be successful unless the overall system is substantially geared towards educating neither too few nor too many essential health care workers.

4) Technical Criteria for a Satisfactory Planning Model

The technical criteria for a workable, satisfactory planning model include:

1. A clear formulation of the issues, problems to be resolved. This implies a statement of objectives.
2. The issues/problems must be formulated in a quantifiable manner, which will usually involve breaking down the main problem into a set of modules involving sub-issues that need to be addressed. The sub-issues or modules must also be formulated in a quantifiable manner.
3. Data of an acceptable quality must be available or collected to use in the various modules that together constitute the model.
4. Responsible parties must check regularly on projections that have been used and up-date them at agreed upon intervals. The purpose is to make adjustments to the equations in the model when necessary or to add new elements if legislative or educational or other relevant changes are introduced that affect the system being studied
5. The planning horizon in terms of time lines must be sufficient to be able to take action to solve identified problems.

The principles described above will be used in the construction of a planning model for the anesthesiology workforce.

5) Steps Required to Implement Workforce Planning

The steps that need to be taken to implement workforce planning include:

- Setting a target date or rolling target dates. The target date is the time point for which a plan is being made.
- Figuring out the situation at the start point in the planning process. This involves ascertaining whether a surplus or shortage of physicians exists at the start point and the extent of the surplus or shortage.
- Figuring out the volume of demand for services to be delivered at the target date(s)
- Based on the volume of demand for services at the target date(s), figuring out which health care professionals will deliver the services and how many of each type of health care professional will be require to deliver the services.
- Figuring out how many physicians there would be absent any intervention to change the institutions and policies that currently determine physician numbers.
- Devise a plan, i.e., implement policies to reconcile supply at the target date(s) with demand at the target date(s).

Each of these steps is described in greater detail below.

a) Planning horizons: choosing time lines

Any planning must involve a start date and a target date. The target date is the time point to which planning is directed. The start date is often referred to as the base date, and in the sections of this paper involving the use of statistical data, the term base date will be used to describe the time period in which planning was initiated.

Choosing a target date or dates is an important consideration in the planning process. We are all familiar with the expressions short term, medium term and long term planning. But what exactly is “short term” or “medium term” or “long term” in the context of a specialty specific planning model?

Listening carefully to how people refer to short term vs. medium or long term planning, it is possible to conclude that anything less than 5 years is assumed to be short term, between 5 and 10 years medium term, and any period longer than 10 years, long term. A little thought about what specialty specific planning entails will lead to the conclusion that these are not useful definitions of short, medium or long term planning for a specialty such as anesthesiology.

To be able to implement policies designed to achieve physician workforce goals, we must have at least enough time to see the results of changes to numbers admitted into entry level specialty programmes and/or changes to numbers admitted to medical schools. The minimum duration in years from entry to medical school to certification, licensure and practice in anesthesiology is 9 years. For major policy changes to produce some minimal impact on the total physician workforce, they need to be in place for a number of years. (The reason for this is that the output of any one year is only a small fraction of the total physician stock.) What this means is that from initiation of a change to undergraduate enrolment levels into Canadian faculties of medicine to a significant impact on the specialty physician workforce, there is a time lag of approximately 15 years.

So, what period of time should we consider short or medium or long term? Certainly a less than 5 years = short term, 5 to 10 years = medium term, more than 10 years = long term is not a sensible time scale for specialty planning. Given the long time lags between the phasing in of policy changes respecting enrolment levels in either an upward or downward direction, suitable benchmarks for short, medium or long term planning horizons would correspond to time intervals as follows:

Up to 10 years = short term
11 to 19 years = medium term
20+ years = long term

Why worry about defining short, medium or long term? The main reason is to assist in choosing a target date for planning. From what has been said above, it should be obvious that it makes little sense to set a target date in the short term time span, because in the short term, work force problems can only be solved with second (or third) best choices. For example, because there is finally acknowledgement that there is a shortage of anesthesiologists, the number of Post-MD training slots in anesthesiology has been somewhat increased in recent years (data in later sections). However, even this will not bear fruit for 5 years from the date when number of trainees increased. The main point to note is that as a generalized shortage of physicians in Canada across almost the full spectrum of fields of practice sets in, the competition between fields for the existing training slots, will make it difficult for any particular field to get an increase in quota. We are already seeing in Canada provincial governments agreeing to increases in training slots without a concomitant commitment to increasing output from medical schools, indicating that the lessons from the last decade have yet to be understood or learned. One of those lessons is the following: ***The fundamental policies we implement today affect the workforce 10 to 15 years hence. They do not solve today's problems or yesterday's. They should be judged accordingly.***

Lesson 1 in physician workforce planning is that the size of a graduating cohort of medical students cannot be altered retrospectively. The consequences for solving immediate problems in the physician workforce of the fact that there are long time lags between implementation of policies and their impact on the workforce will be dealt with in other sections of this paper. Suffice it to say at this point, that from a planning perspective, it makes little sense to think of a target date of less than 15 years from the base date. Although desirable to look beyond a 15 year time period, we need also to remember that the further the time point in the future, the more unreliable are population projections and the more the entire delivery and expectations in the health care system will have changed. New technology and new research change the health care landscape at an ever-accelerating rate. With these factors in mind, we should focus on the time period 10 to 20 years ahead, with a particular emphasis on the period 15 years hence. This does not mean doing nothing in the short term, but rather it means studying what the physician workforce situation ought to be and what it would be, were no intervention to take place in the intervening years, the object being, to steer things in the desired direction.

As has been stated already, using a model for planning is not a one-off affair. Once the infrastructure for running a model has been set up, the usual practice is to operate with moving target dates. Target dates as well as base dates are moved with time, so that the system is under continuing study. Data are regularly updated as each year's data for the numerous incorporated variables become available. For example, if a planning model for the specialty of anesthesiology were to be implemented in the year 2001, the target date could be set at the year 2016, with the base date as the year 2000. If data are checked and updated annually, in the year 2002, the actual (rather than projected) data for the year 2001 would be entered and the planning horizon extended to the year 2017, while still monitoring matters to ensure that the goals for 2016 will be met. Although annual checking and updating will be possible for many variables, it is unlikely that this will be possible for all. The important consideration is that procedures are introduced that lead to vigilance in keeping up with what is going on rather than doing one study and assuming that its findings are valid for long periods of time. Part of this vigilance is choosing target date(s) judiciously and moving them forward on a regular basis.

b) Physician supply situation at the start of the planning process

Establishing what the supply situation is at the start of the planning process involves more than just finding out how many physicians there are at the base date. It involves obtaining reliable information on the age and sex distribution of the physicians in practice, their work patterns (hours worked, type of activities engaged in, both clinical and non-clinical), their geographic location of practice and the population served.

The most difficult and politically sensitive aspect of assessing the current physician supply is getting agreement on whether the current supply is adequate or not. Because of the difficulty in getting agreement amongst all the involved parties (professional medical organizations, educational institutions, governments and the health care administration academics) and the additional difficulty of quantifying any perceived shortage or surplus, the most common practice is to ignore the problem altogether. This is tantamount to assuming that supply is in balance with demand at the start of the planning exercise. Assuming that the existing supply is adequate means that planning will exclude the need to make up deficiencies when there are shortages at the time of commencement of planning, or in the case of surpluses at the outset, to allow for slower levels of new additions to the stock for a while to absorb the surplus.

Although not an altogether precise science, it is not impossible to assess empirically whether there are deficits or surpluses or a rough balance in physician numbers at any particular point in time. For example, when Colleges of Physicians and Surgeons of the provinces are being pressured on all sides to fast track the licensure of physicians from abroad, it is a sure sign of shortage. Objective indicators such as the one just described, give pretty clear signs of whether there are shortages or surpluses even when the picture on the ground may not be to the liking of some of the interested parties. One can be pretty certain that medical associations are not going to call for the education or importation of more doctors if additions to the stock are seen as competitors for a limited client pool. Again, to relate this to a planning model, quantification of any type of an imbalance in physician numbers, positive or negative, at the start of planning is necessary, in order for the information to be incorporated into the model.

c) Figuring out the volume of health care services to be delivered at the target date

Without a doubt, one of the most contentious aspects of planning is getting agreement on a methodology for estimating future physician service requirements. Yet, without such estimates there can be no goal for a plan to reach and hence, nothing to plan. A full review of the various methodologies, good, bad or indifferent, that have been used at one time or another to calculate future physician requirements is well beyond the scope of this paper. It would require a book or a series of books, not a few paragraphs. A methodology is suggested and the reasons for recommending this particular methodology are given.

The first feature of the methodology suggested is the analytical separation of the question of how much service will be required at the target date from questions related to who will deliver the services (what types of health care professionals?) and how many of them will be needed to deliver those services. This is an important distinction that needs to be clearly understood. ***The argument is that the demand/need/requirements for health care services exist independently of the people who may or who may not deliver the services***. It should not be necessary to emphasize this point, but physician workforce analysis in Canada has been heavily influenced by the supply theory of demand for physician services. This theory stresses the power of doctors to enhance their earning potential through the provision of unnecessary or marginally beneficial services to their patients. Without denying the possibility for physicians in a restricted range of fields in a limited way to behave in the manner described, when it comes to the provision of services in anesthesiology, it is safe to conclude that we can ignore the supply induced demand theory. The bulk of work performed by anesthetists is work done at the instigation of other parties, usually surgeons. Anesthetists do not decide when surgery is necessary or how many women are going to need epidurals during childbirth, for example. Even so, this matter is raised because numbers produced from any planning model may well be questioned by arguments based on the supply-induced theory and users of the planning methodology will have to counter the arguments. In what follows, the method suggested for calculating future service requirements is derived from an understanding that the people of Canada experience health care needs. It is their illnesses, frailties, accidents, reproductive choices, etc., that account for demand and not in the first instance, the availability or otherwise of health care professionals.

How can we base our calculations of future levels of demand for health care services squarely on population related factors rather than on physician related factors? There are well-studied and well-known statistical relationships between the demographic variables age & sex on the one hand and the incidence of different types of morbidity, diseases, ailments, etc. The entire, mammoth insurance industry is built on those statistical regularities and their predictability. If actuarial science were not reliable, it would be charlatanry rather than science and the insurance industry would go broke. These same predictable age/sex related levels of morbidity, so useful as the foundation of the insurance industry, give rise to similarly predictable levels of demand for and consumption of health care services. For example, if the numbers in the age group 15 to 45 are increasing, we can be quite certain that the demand for reproductive health care services will increase also. Note, I am not claiming that birth rates will rise in line with increases in the population of child-bearing age, only that the demand for all types of reproduction related services as a whole will increase, i.e., that demand will increase for the total of contraceptive, maternity, abortion and sterilization services.

Changes in population are indisputably associated with changes in the level of demand for health care services. This being the case, any acceptable methodology for estimating future levels of demand for health care services must include as a factor, the projected size and distribution by age and sex of the population at the target date. In run-of the-mill workforce studies population enters into planning through use of the population/physician ratio (PPR), which is defined as the total population divided by the total number of active physicians. This calculation provides a measurement of the average number of persons served per active physician. The population/physician ratio is a simple and convenient measurement for summing up the approximate level of availability of physicians to provide health care services in a society, and for this reason has been the most widely used indicator for tracking physician supply over time and for setting targets for physician supply in the future.

Because of the simplicity of the population/physician ratio (PPR) and its easy availability, why don't we just use it, as have so many others in the past? The straightforward answer is that the PPR does not measure the same the same thing over time. So many studies have compared PPRs over time and when the PPR shows improvement (improvement is defined as a drop in the PPR. A drop occurs when each physician serves fewer people on average compared with an earlier time period), have concluded that there is a surplus of physicians and/or over servicing. These arguments arise out of using "uncorrected" PPRs. Uncorrected PPRs are akin to non-standardized mortality ratios. Nobody who wanted to make a credible comparison of the mortality rates of different countries would compare the computation in country A (crude mortality ratio = number of deaths in a year divided by population multiplied by 100) with a similar computation for country B. Why not? Because the age structures of countries A and B may be very different indeed. If country A has a high birth rate and relatively low life expectancy at birth, but country B has a low birth rate but a relatively long life expectancy at birth, the age distribution of the countries will be quite different. The non-standardized mortality ratio (the crude death rate) for country B could well be higher than that of country A even though the probability of dying is higher in country A in each and every age category. To avoid invidious and misleading statistics, it is routine practice to compare age-standardized mortality rates. This involves comparing the rate of death ***within*** age groups. Thus we compare the mortality ratio of children aged 10 – 14 in country A with the mortality ratio of children aged 10 – 14 in country B. This well recognized statistical practice is called standardization.

The consumption of health care services varies very considerably by age and sex of the population. Over time the age composition of the population changes. So, should we not include in our computations of future health care service requirements, an allowance for changes in the age structure of the population? "Not necessary because it is too insignificant a consideration" say some. "It is a highly significant variable and must be factored in" say others. The author of this paper is firmly in the camp of those who are convinced by the data that not allowing for changes in the age structure of the population is statistical malpractice of the same order as comparing countries' crude death rates rather than standardized mortality ratios.

We all know that older people consume more health care, but can we quantify this sufficiently to be able to use the data in a planning model? Because of the critical importance of this topic in estimating future levels of demand for health care, some of the points made in this section will be illustrated by quoting from a recent study that touched on a number of the issues being discussed here. The study in question was entitled “How many physicians does Canada need to care for our aging population?” The authors were P.Roos, J.E.Bradley, R.Fransoo, M.Shanahan. The article appeared in the CMAJ of May 19, 1998.

This was a large, carefully conducted study which produced many interesting results, including some actual data on the extent to which ageing had increased the utilization of services delivered by physicians over the study period. Several of the findings and comments by the authors on the findings are pertinent to the choice of a method for projecting future demand for health care services and the debates surrounding this subject.

The authors studied growth in physician supply between 1986 and 1994 by province and most specialties (anesthesiology was not included). The growth in physician numbers was compared with the change in population by age and the relative consumption of physician delivered health care by age. It is the findings related to this part of their study that are of interest and what follows is a few quotations from the text of the article:

- “Several studies have suggested that the demographic effects of an aging population are exaggerated”
- Despite assurances from academics that the aging of the population will not stretcher physician supply beyond reasonable limits, physicians themselves and the public remain unconvinced”
- “It cannot be disputed that Canada’s population is aging and that older people consume a disproportionate amount of medical resources relative to younger people.”
- “After numerous interviews and analyses Barer and Stoddart concluded that an optimal number of physicians cannot be defined by purely technical means… Ultimately this is a social rather than a technical judgment. They found no compelling reason for physician growth to exceed population growth.” (Author’s emphasis)
- “We found no evidence in our analysis that the aging of the population will overburden Canada’s physicians. In recent years modest growth in the physician supply has kept pace with large increases in the elderly population.”
- “Overall, Canada’s physician supply between 1986 and 1994 kept pace with population growth and aging.”

In the abstract preceding the article we find under the interpretation section, ***“The aging of Canada’s population poses no threat of shortage to the Canadian physician supply in general, nor to most specialist groups.”*** (emphasis added)

What exactly did this much-cited study find? Are the conclusions reached in the study, as quoted above, consistent with the data reported? To keep this section brief, only the most pertinent, summary findings will be discussed.

Roos et al. state that the population of Canada grew an average of 1.9% each year between 1986 and 1994. (Data were only reported in %, so only % is being used here also.) In Table 4 of their study they indicate that the % change in number of physicians required between 1986 and 1994 to keep pace with population growth and aging was 2.3% per annum. It is a simple piece of arithmetic to deduce from the numbers they presented, that between 1986 and 1994, in **each year** physician numbers needed to increase by 0.4% just to keep pace with ageing (1.9% increase to keep pace with overall population increase; 0.4% increase to keep pace with the ageing of the population; total increase 1.9% + 0.4% = 2.3%). In 1994, there were 55195 active civilian physicians in Canada. Applying the 0.4% ageing factor to a base number of approximately 55000 physicians means that in the single year 1993 to 1994, the physician stock needed to increase by 220 physicians only because of the amount by which the population of 1994 was older than the population of 1993. Transposing these numbers to the context of medium to long term planning, we are talking of cumulative increased requirements amounting over time to thousands of physicians just because of an ageing population.

How does this seemingly tiny 0.4% increase in requirements per annum, derived from the data reported in the study itself, stack up against the conclusions of the experts cited by Roos and her colleagues and their own conclusions?

The first point to note is that the study convincingly demonstrated that during the years of the study, 1986 to 1994, physician supply increased sufficiently to keep pace with both population growth and ageing. However, since the study presented absolutely no data at all on either future demand or supply, how could the authors conclude that they had found no evidence that the ageing of the population would overburden Canada's physician supply in the future? Indeed, since the report was published in 1998, the authors must have been aware that after 1993, physician supply was no longer keeping pace with population growth, let alone increasing enough to meet the additional needs of an ageing population. They were, no doubt, also aware of the Barer/Stoddart recommendations issued in 1991, smack in the middle of the time period they were studying. The Barer/Stoddart recommendation to cut medical school intakes was based on their belief that there was "no compelling reason for physician growth to exceed population growth." This is a roundabout, obfuscating way of saying that PPRs should not be corrected to allow for ageing of the population or indeed, for any other kind of demographic change except for change in the absolute number of people constituting the population.

Once again, the conclusion reported in the interpretation section of the abstract that the ageing of the population poses no threat of future physician shortage cannot be substantiated from the data in the study, because the future was not addressed at all and just assumed to be the same as the past. Just because

physician supply increased 2.9% per annum between 1986 and 1994 didn't prove that it would continue to increase at that rate in subsequent years, and as we know well enough now, it didn't.
In any case, without estimates of future requirements, how are we to know at what rate we wish to see physician supply increase or decrease?

Why bother with this commentary on a paper printed in CMAJ 2 years ago? How is this relevant to a planning model for anesthesia? If ACUDA wishes to introduce workforce planning, criticism of the levels of the projected future demand for services will undoubtedly be encountered, if the projections exceed what is required strictly to keep pace with population growth. Governments are briefed with the type of conclusions I have quoted above and will certainly have been "assured by academics that the aging of the population will not stretch our physician supply beyond reasonable limits" and it will be necessary to argue the point of how, why and to what extent demographic change, over and above changes in the total number of persons, influences demand for health care services.

In the proposed model, the algorithm for calculating future demand will be based on observed age/sex rates of consumption of anesthesiology services applied to the projected future population disaggregated by age & by sex.

This will differ in two major ways from the methods by which Barer/Stoddart and Roos et al reached their conclusions about physician supply. First of all, future demand will be calculated based on population change corrected for age & sex changes in population composition. It is perhaps worthwhile noting that correcting for changes in demographic composition can result in estimates of future requirements increasing either faster or slower than the rate of change in overall population numbers. Secondly, future physician supply will be estimated on the basis of actual and anticipated trends in the flows of physicians into and out of practice, not on extrapolations of changes in total physician numbers, assuming that past trends will continue forever. Questions related to estimating future physician supply are dealt with in detail in another section.

One final point on this topic: 0.4% does not sound like very much at all. But we must remember that it is 0.4% cumulatively year after year and that the entire stock of physicians does not turn over each year. All additional requirements must come from new inflows, so the correct comparison is with the number of expected new entrant physicians each year. As Canada's medical schools are graduating less than 1600 persons each year, the "negligible" factor of ageing is already absorbing about 14% of each year's output! This output has to cover replacements due to departure from practice for any and all reasons as well as increased requirements due to population increases.

Over the medium to long term, what is the compounded effect of ageing? At compound rates of 0.4% per year, the physician stock needs to increase by 4.1%

after 10 years, 6.2% after 15 years and 8.3% after 20 years. If we start with a base of 55000 physicians, other things being equal, after 20 years we need nearly 4600 additional physicians just to take care of the increased needs of the older population. Are these numbers, the entire current output of 3 years of Canadian medical schools, too insignificant to be of concern? Hardly!

Remembering that the 0.4% figure from the Roos et al study applies to all physicians and that ageing of the population is of greater or lesser relevance to the practice profile of different specialties, it will be necessary to make independent estimates of the impact of ageing for each specialty. The impact of ageing and other demographic factors in the specialty of anesthesia will be quantified in a later section.

For all the reasons given above, the method proposed for calculating future demand will include, but not be restricted to the following:

- Measuring the utilization of services by age and sex in the base period (i.e., calculating actual levels of consumption of health care services by age group and by sex).
- Obtaining population projections for the target date or dates.
- Estimating future service requirements, assuming levels of consumption at the target date(s) match those at the base date. This involves multiplying the number of persons in each age/sex category in the target date by the level of consumption of services observed in the base year and summing to obtain total service requirements for the entire population.

Because norms of medical practice will undoubtedly change between the base date and the target date, it also makes sense to consider trends in the way health care services are being delivered and the likely direction of change in areas that will affect future consumption of services. Such factors include, for example, the impact on demand for anesthesiology services of the rapid expansion of minimally invasive surgery, the replacement of some surgery with chemotherapy, the intensification of the level of service delivery to older segments of the population, the growth and development of new fields of practice such as pain management, etc. It is also possible to envisage scenarios that lead to an increase in the efficiency of the delivery of services (e.g., increased use of technicians) as well as decreases in efficiency (e.g., nurse shortages, lack of operating room time).

The inclusion of such considerations will lead to a decrease in servicing in some cases and to an expansion in others. If it is feasible to quantify some of these assessments of the direction of change in the practice environment of anesthesiology, the quantifications can be incorporated into the model.

The infrastructure required for running a well-administered model would include working groups of medical/surgical experts who would advise on the factors influencing the demand for services over time so that these expected changes could be quantified and incorporated into the projection model.

In addition to projections of the level of demand for clinical service, it is also necessary to include in the model estimates for requirements arising out of non-clinical functions performed by anesthesiologists. The principal non-clinical functions are related to academic medicine. Measuring the time and human resources devoted to teaching and research are often omitted from estimates of physician requirements. The same is true of administration, whether it is related to clinical practice or academic medicine or professional organizations. Equations used in the model should include non-clinical human resource requirements.

d) Figuring out which health care providers will deliver the demanded health care services at the target date and how many of each kind will be required

In planning the anesthesia workforce, an important task is to apportion the total volume of work in anesthesiology among the different types of provider. In Canada anesthesia services are delivered by specialist anesthesiologists and by some family physicians, mostly in rural areas. A small volume of service is delivered by other specialists such as radiologists, obstetricians, etc. In addition, inhalation technicians help with airways management and in some provinces there are anesthesiology technicians.

There are no nurse anesthetists in Canada at the present time, but that does not mean that programmes to train them could not or should not be introduced. Such specially trained nurses have been functioning satisfactorily in both Sweden and the United States for a very long time, although the role these nurses play in each of their country’s health care system is quite different. In one case, nurse anesthetists play a supporting role in the provision of anesthesia services. In the other, they play an independent role. In the context of medium to long term planning, it is possible to envisage the introduction of new types of provider such as nurse anesthetists. However, no plan should be made that assumes a portion of the workload will be performed by a new type of health care provider unless concrete plans, including the guarantee of provision of resources, for the introduction of the new class of service provider, have been made. The literature of workforce planning is crammed with reports on the potential of substitution to diminish the demand for physician delivered services, usually unaccompanied by any commitment to introduce the physician substitutes or to secure the resources to do so, or even to find out if there is an applicant pool for the new educational programmes that would need to be introduced.

The database used to study the work patterns of anesthesiologists (data presented in later sections), includes only services provided by physicians, so it was not possible to study the contribution made to the delivery of anesthesia services in Canada by technicians, but it is possible to measure quite precisely the contribution of physicians other than anesthetists. The database covers **all** anesthesiology services delivered by physicians in the province of Quebec during the course of an entire year, a very large, comprehensive database indeed. As Quebec uses inhalation therapy technicians (inhalothérapeutes), their contribution to the total workload is not known. In any case, the work performed by the inhalation therapy technicians is additional to the work performed by physicians. By necessity, any quantification presented in this paper has to be restricted to physicians, but it should be recognized that this is a deficiency and that this is an area that requires further research.

Based on statistics reported for Quebec and data collected by The College of Family Physicians of Canada, it is possible to obtain estimates of the proportion of anesthesiology services delivered by different types of physicians. These estimates for Quebec for the year 1998/99 work out as follows:

Anesthetists	96.0%
Family physicians	3.7%
Other specialists	0.3%

Because the use of family physicians to deliver anesthesia services varies by province, the role of non-anesthetists in the delivery of care may be far greater or less than it is for Quebec. For example, based on data covering fee-for service billings (excludes work performed by salaried physicians) in 1998 provided by the Ontario Medical Association derived from OHIP billings data, family physicians are delivering approximately 8.8% of physician delivered anesthesia services in Ontario. The role of family physicians in the delivery of anesthesia services is clearly far more of an issue in Ontario than it is in Quebec. It may be of even greater importance in other provinces.

The implications of the above for a planning model are that Quebec might include in its projections, the assumption that family physicians would deliver 2–4 % of the anesthesiology services, whereas Ontario might assume that 7–9 % of services would be delivered by family physicians. Each province would have to come up with a reasonable estimate or a goal.

e) Translating estimates of demand for services into number of physicians required

Once calculations have been made of the volume of services needed and the share of these services apportioned between different types of provider, we are left with the question of how to get from volumes of service to the number of physicians who are going to deliver the services.

We know that physicians do not all work the same number of hours per week or work the same number of weeks per year. We know that men and women have somewhat different work patterns and that older physicians have different work patterns from those of younger physicians. What this means in practice is that depending on the demographic characteristics of the physician population, a greater or lesser volume of services will be delivered. In short, when counting the number of practicing physicians we have a standardization problem, just as was described for the population figures in an earlier section. (This, by the way, is another reason why comparing physician population ratios over time is misleading. Neither the numerator nor the denominator of the physician population ratio measures the same thing over time.)

The simple solution to the problem of translating service volumes into head counts, which consists in assuming a particular workload per physician and then dividing the total workload volume by the specified average workload, to arrive at the number of physicians required is just not accurate enough. It might work satisfactorily if neither the age nor the sex composition of the physician workforce changed with the passage of time or if average physician workloads stayed constant over time. None of these suppositions holds out. The physician workforce is increasingly female; hours worked by physicians, as measured in statistical studies have varied considerably from year to year and are sensitive to incentive and disincentive schemes; the proportion of the physician workforce aged 60+ has been increasing for many years, and these physicians typically reduce their work hours as they get older.

Physician workforce planners cannot control the age at which medical students graduate or enter practice, nor can they determine the sex distribution of entering or departing physicians. These are variables outside their control and must be taken as givens. Thus manipulating the demographic characteristics that influence practice behaviour is not a tool available to workforce planners.

In theory it does not matter whether a society has 60000 physicians working “full-time” or 120000 physicians working “half-time”. Either of these arrangements would result in the same volume of service being delivered. In the case of 120000 half-time physicians, the number of people being served per physician (i.e., the PPR) would be only half what it would be if the same population were to be served by 60000 full-time physicians. It is extremely important to remember this when physician numbers are being compared over very long periods of time. Like is often not being compared with like.

In order to overcome the problems posed by differing work practices among physicians a standard accounting unit for measuring physician workload has to be found and very often a calculation of full-time equivalents (FTEs) is used. Alas, there are a number of difficulties with the use of FTEs. Only the most serious are mentioned here because otherwise some readers will wonder why FTEs, as they are usually measured, were not suggested for incorporation into the model.

First of all, the most commonly used measure of full-time in workforce planning in

Canada is not an absolute measure but a relative one, and is based on ranges rather than fixed norms. The National Physician Data Base (NPDB) uses an FTE based on earnings. All physicians who earn below a given percentile of all physicians' earnings are designated as part-time; between certain percentile earning ranges they are considered full-time; above a specified amount, they are considered equivalent to more than 1 physician, with fractions such as 1.2 depending on earnings. This may have some utility in summarizing differential amounts of work done by physicians in a single year, but it is not useful for physician manpower planning and hence cannot be recommended as a tool in the planning model. Relative measures are unhelpful because the definition of full-time depends on the average amount of work done by physicians in that year only. There is no way to convert any given volume of work ***by a constant*** to derive a head count of the number of physicians required to deliver services calculated on the same basis from year to year. Using the NPDB's definitions, next year's full-time physician may be delivering more or less service on average, than last year's physician. The difference may not amount to much in a period of 2 years, but the cumulative effect over the full cycle of a physician planning exercise could be very substantial indeed. The reason for this is given in the next paragraph.

The major problem for a planning model is that distinctions such as "full-time" or "part-time" are just not fine enough. ***The demand for physicians is extremely sensitive, one might even say hypersensitive, to the number of hours worked per week***. Take as an example the impact on physician requirements of each physician working just 1 hour less per week. Let us assume a 48-hour week in a system using 60000 physicians. If on average physicians drop their workweek to 47 hours, how many more physicians do we now need to deliver the same volume of service? With the new 47-hour workweek, the system will need physicians to make up 60000 hours (1 hour lost for each of 60000 physicians). Since on average, each physician will now works 47 hours, the number of additional physicians is 60000/47 = 1272. The large impact of small changes in hours worked is usually ignored in workforce studies and is one of the reasons why, with the feminization of the physician workforce, physician requirements are frequently under estimated. In many jurisdictions in Canada, measured physician working hours have been declining for years.

Another important reason for rejecting or limiting the use of FTEs in planning models is that no human being is a fraction. ***Final physician requirements should only be expressed in whole numbers***. The author of this paper has seen well-received studies in which physician requirements were calculated and expressed as FTEs with no correction to allow for head counts. This is a gross error. There have always been physicians who worked reduced hours and there always will be. It is quite simply wrong to calculate the workload of all physicians in terms of full-time equivalents only. FTE counts are usually in number than the actual head count of physicians delivering service. Unless working part-time is to be banned, obviously unthinkable, FTEs are a meaningless concept when it comes to counting flesh and blood physicians for practice. FTEs are a summary measure of work volume, not a measure of physicians as human beings, which is what we require for planning purposes. If demand calculations are made in terms of FTEs, these counts still need to be translated back into a head count measurement.

To solve the problem before us, we need to start with the expected demographics of the physician workforce at the target date. This means estimating the age/sex distribution of the physician workforce as it is expected to be at the target date. By extrapolating the work patterns of the physician workforce in the base year disaggregated by age and sex, to the expected pool of physicians at the target date, we can estimate the volume of work that might be forthcoming from the physician workforce of the future.

Before concluding this section, it is worthwhile considering types of FTE measurements that could be useful in workforce planning.

As has been stated, definitions of FTEs involving relative measurements are hardly worth the effort. However, FTEs can be defined in absolute terms that do not vary from year to year. For example, 1 FTE could be defined as 40 or 45 or 50 hours of work per week (ranges such as 40-45 hours per week do not qualify as an absolute measure). In such situations it would be possible to work out a formula for converting measured work loads expressed in hours worked, into FTEs. Then, based on the observed distribution of work patterns of physicians, into number of physicians required. The difficulty is that most available measurements of physician workload are made in terms of physician earnings. There are no regularly collected, verified, comprehensive data on hours worked. This is why earnings are used as a proxy measurement for time worked. Because earnings are largely based on amounts billed for services and hence proportional to amount of work done, earnings are a reasonable proxy for volume of work done. The use of data series on earnings as a measurement of volume of work done over time necessitates making adjustments because of wage inflation and related factors.

To overcome these seemingly insuperable problems, it is suggested that the following method be used:

Start in the base period by measuring the volume of services consumed by the population by age and sex. Secondly, using population projections by age and sex, calculate the future demand for anesthesia services, assuming that there is some regularity in the differential levels of consumption of service by age and sex.

More sophisticated models may go beyond mere extrapolation of the situation in the base period and incorporate assumptions about expected changes in how service is delivered and the effects of these changes on the rate of utilization of services by age groups in the future.

Once calculations of future demand for anesthesia services have been made, the simplest method for determining the number of physicians required at the target date, is to calculate the % change in services between the base period and the target date and to assume that the same % change in number of physicians will be required. This is a long-winded way of saying that if demand for service increases 5%, then the number of physicians required will also increase by 5%.

This simple formulation may be a reasonable starting point, but it is also necessary to take into consideration the demographic composition of the physician workforce in the base period and the target date in order to adjust the estimated number of future physicians required in the light of workforce patterns that will result from demographic changes. Examples of demographic change associated with altered work patterns are: a younger physician workforce implies longer average work weeks and consequently fewer physicians required to perform a given volume of work; an older physician work force implies the opposite and a more feminized work force implies shorter average working hours and, by inference, a larger number of physicians to perform a given volume of work. Given the extreme sensitivity of physician requirements to average hours worked, these considerations are not negligible.

It has been shown, depending on the province in question, that non-anesthetists may deliver a greater or lesser proportion of anesthesia services. For family physicians or other specialists who deliver some anesthesia services, anesthesia is rarely their principal field of medical activity. This has implications for the number of such physicians required to deliver a given volume of service. An example using data from Quebec illustrates this neatly. These data come from the database of the Régie de l'Assurance Maladie du Québec (RAMQ) and refer to amounts billed for anesthesia services for the fiscal year 1998/99.

The data reported show the average amounts billed in Quebec by different types of physicians for anesthesia services in 1998/99 and the number of providers who delivered services.

Type of Provider of Anesthesia Services	**Number of Providers**	**Average billings in 1998/99**	**Total Billings**
Anesthetists	529	$188966	$ 99962998
Family Physicians	189	$ 20526	$ 3879454
Other Specialists	156	$ 2232	$ 348148
Total	874	$119211	$104190600

From this table we learn that anesthetists constituted 60.5% of all the physicians who delivered anesthesia services in Quebec, but that they provided 96 % of all the anesthesia services; family physicians constituted 21,6% of all the physicians who delivered anesthesia services and they delivered 3.7% of the services; other specialists although 17.8% of the physicians who delivered anesthesia services, actually delivered only 0.3% of the services.

From these data we can infer that specialists other than anesthetists deliver anesthesia services only on a very episodic basis. However, family physicians, who provide much-needed anesthesia services in rural and low population areas, are required in far greater numbers than would be supposed by looking only at the total amount of service they provide. If concepts such as FTEs were used to calculate the number of family physicians required to deliver anesthesia services, the conclusions reached would be quite erroneous. In the case of Quebec in 1998/99, if $175000 were considered to be the equivalent to the amount earned by 1 FTE, we would conclude that Quebec “needed” 22 FTEs to deliver anesthesia services, although the data show that it took 189 family physicians to deliver the services.

When decisions are made about the provision of slots for extra Post-MD training in anesthesia for family physicians, it is necessary to include in the planning model norms that allow for the fact that anesthesia services will not be the major professional activity of most family physicians delivering those services. In brief, it is necessary to train a relatively large number of individuals to provide a relatively small amount of service.

f) Figuring out how many physicians there would be absent any intervention to change institutions and policies that currently determine physician numbers

In order to work out a plan of action to achieve workforce goals for the target date, we need to have some idea of where we would be if we took no action at all.

The customary way of handling this is to calculate output from medical schools and Post-MD clinical training programmes, make some assumptions about physician immigration and emigration, about retirements, deaths and other reasons for quitting medicine. If planning is at the provincial level, calculations also include internal migration (movement between provinces). Some kind of a balance sheet is arrived at after measuring inflows into practice and outflows, resulting in an estimate of physician supply each year. It is also customary, data being available, to disaggregate physician counts to obtain future estimates of physician numbers by age and sex.

The methodology for obtaining these estimates of future physician supply is elaborated in greater detail in a later section. Here it is necessary to discuss aspects of making supply estimates that lead to errors in the projections

The difficulty arises out of assuming that certain types of behaviour do not change over the life of a planning exercise. Let us assume that we were conducting a projection exercise of the type described in the preceding paragraphs. The statistical data we would use would include:

- A projection of the output of medical schools according to current levels of intake each year
- A projection of the number of graduates of foreign medical schools earning licensure and entering practice in Canada in line with numbers for recent years
- A projection of the output of the different specialty programmes based on the share of each specialty in the number of Post-MD positions in recent years etc.

Projections made mechanically using observed values of the coefficients in the projection model do not take into account society's responses to workforce problems that occur from time to time. A striking manifestation of this is what occurs when a physician shortage is in the offing or being experienced. Physicians and hospitals cannot tell their patients to come back in 10 to 15 years, by which time the institutions responsible for educating physicians will have turned out enough of them to meet the demands of the health care system. Real shortages have to be dealt with immediately. The easiest solution to shortages of physicians is to import them from abroad, thus eliminating the long lead times between the moment of recognition of need and the production of additional physicians. At the time of writing this paper (summer of the year 2000), all over Canada we are witnessing attempts to bring in needed physicians from other countries as quickly as possible. This will, if successful, change the statistical trends showing the number of physicians entering practice in Canada who earned the M.D. abroad.

There are 2 ways to deal with this type of phenomenon in making estimates of what the physician supply will be in the future. The first is to build into the estimates an allowance for increased physician immigration. The second is to do what has already been recommended as an essential feature of quality planning models: regularly update all the coefficients used in the model with the latest available data to reflect changes as they occur. This type of dynamic planning should replace mechanistic extrapolation of past trends indefinitely into the future.

In the short run, it may be difficult to make realistic estimates of the extent of increased licensure of physicians from abroad because the success of recruitment programmes cannot be guaranteed in advance. The regulatory and legal environment surrounding licensure today is such that it may be more difficult than in the past to recruit heavily from abroad.

Let us assume that recruitment abroad is successful, it is easy to conceive of a situation in which governmental authorities finally and belatedly accept the desirability of increasing output from Canadian medical schools. By the time this is done the attempts to deal with shortages through foreign recruitment may have made a dent in the numbers needed from Canadian institutions. Something like this happened following the first major planning exercise of physician manpower in Canada that took place in the ’60s.

The implication of the foregoing for the model for anesthesiology is that the projected supply of anesthetists at the target date should include a grossing up of the numbers to reflect the expected influx of anesthetists from other countries as new paths for the assessing and licensure of anesthetists educated outside Canada are being introduced.

g) Devising a plan and implementing policies to reconcile supply at the target date(s) with demand

The processes described in the previous sections will generate two independently arrived at estimates or ranges of estimates. The first estimates will be of the number of physicians required at the target date. The second will be of the number of physicians expected to be in practice at the target date. The difference between these two sets of numbers will indicate whether there will be a surplus, an approximate balance or physician shortage at the target date and provide magnitudes so that the seriousness of the situation can be assessed. (The expression “range of estimates” appears here although, in order to keep the text as simple as possible, the use of ranges has not been raised so far. Most estimates can be, and usually should be, expressed as ranges. When a model is set up and programmed, it is much easier to incorporate ranges into calculations. An example of expressing coefficients in terms of ranges is “if immigration into Canada is between 100000 and 150000 persons per year”, rather than assuming a point estimate of, say, 125000 a year. Using range formulations results in a range of possible outcomes rather than a single possibility.)

Once the operation of the model has led to a conclusion that there will be either a balance or surplus or shortage of physicians at the target date, decisions must be taken as to how to mould the future in the desired direction. This phase of operations might be designated as the “plan” and will inevitably involve political considerations that will bring into play provincial and federal governmental authorities as well as the national and provincial educational and medical professional bodies.

Available responses may include increasing or decreasing medical school enrolment, increasing or decreasing the provision of specialty training opportunities, encouraging substitution of some types of service providers with other types (not by talking about it, but by actually doing it), encouraging or discouraging physician immigration, etc. In any case, the part played by the modeling process will be taken over at this stage by policy making. The model may help in simulating the results of proposed solutions, in order to encourage the use of effective decision making, but models are only mechanical number crunchers. They only spew out what has been programmed into them. It is for the political establishment to make policy respecting future physician supply and how to achieve workforce goals.

Because of the complicated, should one say internecine, nature of the politics involved in physician resource decision making, it is extremely important that contributors to the planning model include professional medical associations, provincial governments, medical schools and health administration academics. Only if all these parties agree on the values of the coefficients used in the model at the input stage will they agree with the results generated by the model. Only if that consensus exists, will rational decision-making follow on conclusions arrived at from the modelling process.

The College of Physicians of Quebec has been operating a physician planning model for many years now. One of its greatest benefits derives from the cooperation and input of all interested parties, so that despite a divergence of interests among many of the parties involved, at least there is no longer suspicion about the validity of the numbers entered into the model or the projections emanating from the model. This situation was not achieved overnight, but only after years of cooperation. Unfortunately, a similar situation does not yet exist in the rest of Canada, as has so amply been demonstrated in recent years when medical associations claimed that physician shortages were imminent whereas governments, based on advice from academics that was not derived from quantitative studies or modelling of any kind, claimed that there were too many doctors.

The cooperative work environment in which the Quebec model is run can lead to rapid decision-making and implementation. This is not meant to suggest that physician work force issues have been depoliticized in Quebec. That would be expecting too much. But it does mean that the parties to decisions, including the provincial government participants, are generally well informed and relatively sophisticated users of the data. This was illustrated a few months ago when the government of Quebec was the first jurisdiction in Canada to reverse the decisions to reduce medical school enrolment made following implementation of the Barer-Stoddart recommendations. Starting in the autumn of 2000, intake into Quebec medical schools will be increased substantially.

To conclude this section, a planning model can be a very useful tool for those who have to plan the physician workforce. Because of the long lead times in producing results from changed physician workforce policies, problems have to be anticipated and solutions implemented years before the problems actually appear. This necessitates having reliable projections. The time to increase medical school places is years before there is a manifest physician shortage. A good model can help, but only if all parties agree on its utility. The best model in the world will be of little practical utility if the authorities that have to take decisions pay no attention.

5) Steps Required to Implement Workforce Planning

The steps that need to be taken to implement workforce planning include:

- Setting a target date or rolling target dates. The target date is the time point for which a plan is being made.
- Figuring out the situation at the start point in the planning process. This involves ascertaining whether a surplus or shortage of physicians exists at the start point and the extent of the surplus or shortage.
- Figuring out the volume of demand for services to be delivered at the target date(s)
- Based on the volume of demand for services at the target date(s), figuring out which health care professionals will deliver the services and how many of each type of health care professional will be require to deliver the services.
- Figuring out how many physicians there would be absent any intervention to change the institutions and policies that currently determine physician numbers.
- Devise a plan, i.e., implement policies to reconcile supply at the target date(s) with demand at the target date(s).

Each of these steps is described in greater detail below.

a) Planning horizons: choosing time lines

Any planning must involve a start date and a target date. The target date is the time point to which planning is directed. The start date is often referred to as the base date, and in the sections of this paper involving the use of statistical data, the term base date will be used to describe the time period in which planning was initiated.

Choosing a target date or dates is an important consideration in the planning process. We are all familiar with the expressions short term, medium term and long term planning. But what exactly is “short term” or “medium term” or “long term” in the context of a specialty specific planning model?

Listening carefully to how people refer to short term vs. medium or long term planning, it is possible to conclude that anything less than 5 years is assumed to be short term, between 5 and 10 years medium term, and any period longer than 10 years, long term. A little thought about what specialty specific planning entails will lead to the conclusion that these are not useful definitions of short, medium or long term planning for a specialty such as anesthesiology.

To be able to implement policies designed to achieve physician workforce goals, we must have at least enough time to see the results of changes to numbers admitted into entry level specialty programmes and/or changes to numbers admitted to medical schools. The minimum duration in years from entry to medical school to certification, licensure and practice in anesthesiology is 9 years. For major policy changes to produce some minimal impact on the total physician workforce, they need to be in place for a number of years. (The reason for this is that the output of any one year is only a small fraction of the total physician stock.) What this means is that from initiation of a change to undergraduate enrolment levels into Canadian faculties of medicine to a significant impact on the specialty physician workforce, there is a time lag of approximately 15 years.

So, what period of time should we consider short or medium or long term? Certainly a less than 5 years = short term, 5 to 10 years = medium term, more than 10 years = long term is not a sensible time scale for specialty planning. Given the long time lags between the phasing in of policy changes respecting enrolment levels in either an upward or downward direction, suitable benchmarks for short, medium or long term planning horizons would correspond to time intervals as follows:

Up to 10 years	= short term
11 to 19 years	= medium term
20+ years	= long term

Why worry about defining short, medium or long term? The main reason is to assist in choosing a target date for planning. From what has been said above, it should be obvious that it makes little sense to set a target date in the short term time span, because in the short term, work force problems can only be solved with second (or third) best choices. For example, because there is finally acknowledgement that there is a shortage of anesthesiologists, the number of Post-MD training slots in anesthesiology has been somewhat increased in recent years (data in later sections). However, even this will not bear fruit for 5 years from the date when number of trainees increased. The main point to note is that as a generalized shortage of physicians in Canada across almost the full spectrum of fields of practice sets in, the competition between fields for the existing training slots, will make it difficult for any particular field to get an increase in quota. We are already seeing in Canada provincial governments agreeing to increases in training slots without a concomitant commitment to increasing output from medical schools, indicating that the lessons from the last decade have yet to be understood or learned. One of those lessons is the following: ***The fundamental policies we implement today affect the workforce 10 to 15 years hence. They do not solve today's problems or yesterday's. They should be judged accordingly.***

Lesson 1 in physician workforce planning is that the size of a graduating cohort of medical students cannot be altered retrospectively. The consequences for solving immediate problems in the physician workforce of the fact that there are long time lags between implementation of policies and their impact on the workforce will be dealt with in other sections of this paper. Suffice it to say at this point, that from a planning perspective, it makes little sense to think of a target date of less than 15 years from the base date. Although desirable to look beyond a 15 year time period, we need also to remember that the further the time point in the future, the more unreliable are population projections and the more the entire delivery and expectations in the health care system will have changed. New technology and new research change the health care landscape at an ever-accelerating rate. With these factors in mind, we should focus on the time period 10 to 20 years ahead, with a particular emphasis on the period 15 years hence. This does not mean doing nothing in the short term, but rather it means studying what the physician workforce situation ought to be and what it would be, were no intervention to take place in the intervening years, the object being, to steer things in the desired direction.

As has been stated already, using a model for planning is not a one-off affair. Once the infrastructure for running a model has been set up, the usual practice is to operate with moving target dates. Target dates as well as base dates are moved with time, so that the system is under continuing study. Data are regularly updated as each year's data for the numerous incorporated variables become available. For example, if a planning model for the specialty of anesthesiology were to be implemented in the year 2001, the target date could be set at the year 2016, with the base date as the year 2000. If data are checked and updated annually, in the year 2002, the actual (rather than projected) data for the year 2001 would be entered and the planning horizon extended to the year 2017, while still monitoring matters to ensure that the goals for 2016 will be met. Although annual checking and updating will be possible for many variables, it is unlikely that this will be possible for all. The important consideration is that procedures are introduced that lead to vigilance in keeping up with what is going on rather than doing one study and assuming that its findings are valid for long periods of time. Part of this vigilance is choosing target date(s) judiciously and moving them forward on a regular basis.

b) Physician supply situation at the start of the planning process

Establishing what the supply situation is at the start of the planning process involves more than just finding out how many physicians there are at the base date. It involves obtaining reliable information on the age and sex distribution of the physicians in practice, their work patterns (hours worked, type of activities engaged in, both clinical and non-clinical), their geographic location of practice and the population served.

The most difficult and politically sensitive aspect of assessing the current physician supply is getting agreement on whether the current supply is adequate or not. Because of the difficulty in getting agreement amongst all the involved parties (professional medical organizations, educational institutions, governments and the health care administration academics) and the additional difficulty of quantifying any perceived shortage or surplus, the most common practice is to ignore the problem altogether. This is tantamount to assuming that supply is in balance with demand at the start of the planning exercise. Assuming that the existing supply is adequate means that planning will exclude the need to make up deficiencies when there are shortages at the time of commencement of planning, or in the case of surpluses at the outset, to allow for slower levels of new additions to the stock for a while to absorb the surplus.

Although not an altogether precise science, it is not impossible to assess empirically whether there are deficits or surpluses or a rough balance in physician numbers at any particular point in time. For example, when Colleges of Physicians and Surgeons of the provinces are being pressured on all sides to fast track the licensure of physicians from abroad, it is a sure sign of shortage. Objective indicators such as the one just described, give pretty clear signs of whether there are shortages or surpluses even when the picture on the ground may not be to the liking of some of the interested parties. One can be pretty certain that medical associations are not going to call for the education or importation of more doctors if additions to the stock are seen as competitors for a limited client pool. Again, to relate this to a planning model, quantification of any type of an imbalance in physician numbers, positive or negative, at the start of planning is necessary, in order for the information to be incorporated into the model.

c) Figuring out the volume of health care services to be delivered at the target date

Without a doubt, one of the most contentious aspects of planning is getting agreement on a methodology for estimating future physician service requirements. Yet, without such estimates there can be no goal for a plan to reach and hence, nothing to plan. A full review of the various methodologies, good, bad or indifferent, that have been used at one time or another to calculate future physician requirements is well beyond the scope of this paper. It would require a book or a series of books, not a few paragraphs. A methodology is suggested and the reasons for recommending this particular methodology are given.

The first feature of the methodology suggested is the analytical separation of the question of how much service will be required at the target date from questions related to who will deliver the services (what types of health care professionals?) and how many of them will be needed to deliver those services. This is an important distinction that needs to be clearly understood. ***The argument is that the demand/need/requirements for health care services exist independently of the people who may or who may not deliver the services***. It should not be necessary to emphasize this point, but physician workforce analysis in Canada has been heavily influenced by the supply theory of demand for physician services. This theory stresses the power of doctors to enhance their earning potential through the provision of unnecessary or marginally beneficial services to their patients. Without denying the possibility for physicians in a restricted range of fields in a limited way to behave in the manner described, when it comes to the provision of services in anesthesiology, it is safe to conclude that we can ignore the supply induced demand theory. The bulk of work performed by anesthetists is work done at the instigation of other parties, usually surgeons. Anesthetists do not decide when surgery is necessary or how many women are going to need epidurals during childbirth, for example. Even so, this matter is raised because numbers produced from any planning model may well be questioned by arguments based on the supply-induced theory and users of the planning methodology will have to counter the arguments. In what follows, the method suggested for calculating future service requirements is derived from an understanding that the people of Canada experience health care needs. It is their illnesses, frailties, accidents, reproductive choices, etc., that account for demand and not in the first instance, the availability or otherwise of health care professionals.

How can we base our calculations of future levels of demand for health care services squarely on population related factors rather than on physician related factors? There are well-studied and well-known statistical relationships between the demographic variables age & sex on the one hand and the incidence of different types of morbidity, diseases, ailments, etc. The entire, mammoth insurance industry is built on those statistical regularities and their predictability. If actuarial science were not reliable, it would be charlatanry rather than science and the insurance industry would go broke. These same predictable age/sex related levels of morbidity, so useful as the foundation of the insurance industry, give rise to similarly predictable levels of demand for and consumption of health care services. For example, if the numbers in the age group 15 to 45 are increasing, we can be quite certain that the demand for reproductive health care services will increase also. Note, I am not claiming that birth rates will rise in line with increases in the population of child-bearing age, only that the demand for all types of reproduction related services as a whole will increase, i.e., that demand will increase for the total of contraceptive, maternity, abortion and sterilization services.

Changes in population are indisputably associated with changes in the level of demand for health care services. This being the case, any acceptable methodology for estimating future levels of demand for health care services must include as a factor, the projected size and distribution by age and sex of the population at the target date. In run-of the-mill workforce studies population enters into planning through use of the population/physician ratio (PPR), which is defined as the total population divided by the total number of active physicians. This calculation provides a measurement of the average number of persons served per active physician. The population/physician ratio is a simple and convenient measurement for summing up the approximate level of availability of physicians to provide health care services in a society, and for this reason has been the most widely used indicator for tracking physician supply over time and for setting targets for physician supply in the future.

Because of the simplicity of the population/physician ratio (PPR) and its easy availability, why don't we just use it, as have so many others in the past? The straightforward answer is that the PPR does not measure the same the same thing over time. So many studies have compared PPRs over time and when the PPR shows improvement (improvement is defined as a drop in the PPR. A drop occurs when each physician serves fewer people on average compared with an earlier time period), have concluded that there is a surplus of physicians and/or over servicing. These arguments arise out of using "uncorrected" PPRs. Uncorrected PPRs are akin to non-standardized mortality ratios. Nobody who wanted to make a credible comparison of the mortality rates of different countries would compare the computation in country A (crude mortality ratio = number of deaths in a year divided by population multiplied by 100) with a similar computation for country B. Why not? Because the age structures of countries A and B may be very different indeed. If country A has a high birth rate and relatively low life expectancy at birth, but country B has a low birth rate but a relatively long life expectancy at birth, the age distribution of the countries will be quite different. The non-standardized mortality ratio (the crude death rate) for country B could well be higher than that of country A even though the probability of dying is higher in country A in each and every age category. To avoid invidious and misleading statistics, it is routine practice to compare age-standardized mortality rates. This involves comparing the rate of death ***within*** age groups. Thus we compare the mortality ratio of children aged 10 – 14 in country A with the mortality ratio of children aged 10 – 14 in country B. This well recognized statistical practice is called standardization.

The consumption of health care services varies very considerably by age and sex of the population. Over time the age composition of the population changes. So, should we not include in our computations of future health care service requirements, an allowance for changes in the age structure of the population? "Not necessary because it is too insignificant a consideration" say some. "It is a highly significant variable and must be factored in" say others. The author of this paper is firmly in the camp of those who are convinced by the data that not allowing for changes in the age structure of the population is statistical malpractice of the same order as comparing countries' crude death rates rather than standardized mortality ratios.

We all know that older people consume more health care, but can we quantify this sufficiently to be able to use the data in a planning model? Because of the critical importance of this topic in estimating future levels of demand for health care, some of the points made in this section will be illustrated by quoting from a recent study that touched on a number of the issues being discussed here. The study in question was entitled “How many physicians does Canada need to care for our aging population?” The authors were P.Roos, J.E.Bradley, R.Fransoo, M.Shanahan. The article appeared in the CMAJ of May 19, 1998.

This was a large, carefully conducted study which produced many interesting results, including some actual data on the extent to which ageing had increased the utilization of services delivered by physicians over the study period. Several of the findings and comments by the authors on the findings are pertinent to the choice of a method for projecting future demand for health care services and the debates surrounding this subject.

The authors studied growth in physician supply between 1986 and 1994 by province and most specialties (anesthesiology was not included). The growth in physician numbers was compared with the change in population by age and the relative consumption of physician delivered health care by age. It is the findings related to this part of their study that are of interest and what follows is a few quotations from the text of the article:

- “Several studies have suggested that the demographic effects of an aging population are exaggerated”
- Despite assurances from academics that the aging of the population will not stretcher physician supply beyond reasonable limits, physicians themselves and the public remain unconvinced”
- “It cannot be disputed that Canada’s population is aging and that older people consume a disproportionate amount of medical resources relative to younger people.”
- “After numerous interviews and analyses Barer and Stoddart concluded that an optimal number of physicians cannot be defined by purely technical means… Ultimately this is a social rather than a technical judgment. They found no compelling reason for physician growth to exceed population growth.” (Author’s emphasis)
- “We found no evidence in our analysis that the aging of the population will overburden Canada’s physicians. In recent years modest growth in the physician supply has kept pace with large increases in the elderly population.”
- “Overall, Canada’s physician supply between 1986 and 1994 kept pace with population growth and aging.”

In the abstract preceding the article we find under the interpretation section, ***“The aging of Canada’s population poses no threat of shortage to the Canadian physician supply in general, nor to most specialist groups.”*** (emphasis added)

What exactly did this much-cited study find? Are the conclusions reached in the study, as quoted above, consistent with the data reported? To keep this section brief, only the most pertinent, summary findings will be discussed.

Roos et al. state that the population of Canada grew an average of 1.9% each year between 1986 and 1994. (Data were only reported in %, so only % is being used here also.) In Table 4 of their study they indicate that the % change in number of physicians required between 1986 and 1994 to keep pace with population growth and aging was 2.3% per annum. It is a simple piece of arithmetic to deduce from the numbers they presented, that between 1986 and 1994, in **each year** physician numbers needed to increase by 0.4% just to keep pace with ageing (1.9% increase to keep pace with overall population increase; 0.4% increase to keep pace with the ageing of the population; total increase 1.9% + 0.4% = 2.3%). In 1994, there were 55195 active civilian physicians in Canada. Applying the 0.4% ageing factor to a base number of approximately 55000 physicians means that in the single year 1993 to 1994, the physician stock needed to increase by 220 physicians only because of the amount by which the population of 1994 was older than the population of 1993. Transposing these numbers to the context of medium to long term planning, we are talking of cumulative increased requirements amounting over time to thousands of physicians just because of an ageing population.

How does this seemingly tiny 0.4% increase in requirements per annum, derived from the data reported in the study itself, stack up against the conclusions of the experts cited by Roos and her colleagues and their own conclusions?

The first point to note is that the study convincingly demonstrated that during the years of the study, 1986 to 1994, physician supply increased sufficiently to keep pace with both population growth and ageing. However, since the study presented absolutely no data at all on either future demand or supply, how could the authors conclude that they had found no evidence that the ageing of the population would overburden Canada's physician supply in the future? Indeed, since the report was published in 1998, the authors must have been aware that after 1993, physician supply was no longer keeping pace with population growth, let alone increasing enough to meet the additional needs of an ageing population. They were, no doubt, also aware of the Barer/Stoddart recommendations issued in 1991, smack in the middle of the time period they were studying. The Barer/Stoddart recommendation to cut medical school intakes was based on their belief that there was "no compelling reason for physician growth to exceed population growth." This is a roundabout, obfuscating way of saying that PPRs should not be corrected to allow for ageing of the population or indeed, for any other kind of demographic change except for change in the absolute number of people constituting the population.

Once again, the conclusion reported in the interpretation section of the abstract that the ageing of the population poses no threat of future physician shortage cannot be substantiated from the data in the study, because the future was not addressed at all and just assumed to be the same as the past. Just because

physician supply increased 2.9% per annum between 1986 and 1994 didn't prove that it would continue to increase at that rate in subsequent years, and as we know well enough now, it didn't.
In any case, without estimates of future requirements, how are we to know at what rate we wish to see physician supply increase or decrease?

Why bother with this commentary on a paper printed in CMAJ 2 years ago? How is this relevant to a planning model for <u>anesthesia</u>? If ACUDA wishes to introduce workforce planning, criticism of the levels of the projected future demand for services will undoubtedly be encountered, if the projections exceed what is required strictly to keep pace with population growth. Governments are briefed with the type of conclusions I have quoted above and will certainly have been "assured by academics that the aging of the population will not stretch our physician supply beyond reasonable limits" and it will be necessary to argue the point of how, why and to what extent demographic change, over and above changes in the total number of persons, influences demand for health care services.

In the proposed model, the algorithm for calculating future demand will be based on observed age/sex rates of consumption of anesthesiology services applied to the projected future population disaggregated by age & by sex.

This will differ in two major ways from the methods by which Barer/Stoddart and Roos et al reached their conclusions about physician supply. First of all, future demand will be calculated based on population change corrected for age & sex changes in population composition. It is perhaps worthwhile noting that correcting for changes in demographic composition can result in estimates of future requirements increasing either faster or slower than the rate of change in overall population numbers. Secondly, future physician supply will be estimated on the basis of actual and anticipated trends in the flows of physicians into and out of practice, not on extrapolations of changes in total physician numbers, assuming that past trends will continue forever. Questions related to estimating future physician supply are dealt with in detail in another section.

One final point on this topic: 0.4% does not sound like very much at all. But we must remember that it is 0.4% cumulatively year after year and that the entire stock of physicians does not turn over each year. All additional requirements must come from new inflows, so the correct comparison is with the number of expected new entrant physicians each year. As Canada's medical schools are graduating less than 1600 persons each year, the "negligible" factor of ageing is already absorbing about 14% of each year's output! This output has to cover replacements due to departure from practice for any and all reasons as well as increased requirements due to population increases.

Over the medium to long term, what is the compounded effect of ageing? At compound rates of 0.4% per year, the physician stock needs to increase by 4.1%

after 10 years, 6.2% after 15 years and 8.3% after 20 years. If we start with a base of 55000 physicians, other things being equal, after 20 years we need nearly 4600 additional physicians just to take care of the increased needs of the older population. Are these numbers, the entire current output of 3 years of Canadian medical schools, too insignificant to be of concern? Hardly!

Remembering that the 0.4% figure from the Roos et al study applies to all physicians and that ageing of the population is of greater or lesser relevance to the practice profile of different specialties, it will be necessary to make independent estimates of the impact of ageing for each specialty. The impact of ageing and other demographic factors in the specialty of anesthesia will be quantified in a later section.

For all the reasons given above, the method proposed for calculating future demand will include, but not be restricted to the following:

- Measuring the utilization of services by age and sex in the base period (i.e., calculating actual levels of consumption of health care services by age group and by sex).
- Obtaining population projections for the target date or dates.
- Estimating future service requirements, assuming levels of consumption at the target date(s) match those at the base date. This involves multiplying the number of persons in each age/sex category in the target date by the level of consumption of services observed in the base year and summing to obtain total service requirements for the entire population.

Because norms of medical practice will undoubtedly change between the base date and the target date, it also makes sense to consider trends in the way health care services are being delivered and the likely direction of change in areas that will affect future consumption of services. Such factors include, for example, the impact on demand for anesthesiology services of the rapid expansion of minimally invasive surgery, the replacement of some surgery with chemotherapy, the intensification of the level of service delivery to older segments of the population, the growth and development of new fields of practice such as pain management, etc. It is also possible to envisage scenarios that lead to an increase in the efficiency of the delivery of services (e.g., increased use of technicians) as well as decreases in efficiency (e.g., nurse shortages, lack of operating room time).

The inclusion of such considerations will lead to a decrease in servicing in some cases and to an expansion in others. If it is feasible to quantify some of these assessments of the direction of change in the practice environment of anesthesiology, the quantifications can be incorporated into the model.

The infrastructure required for running a well-administered model would include working groups of medical/surgical experts who would advise on the factors influencing the demand for services over time so that these expected changes could be quantified and incorporated into the projection model.

In addition to projections of the level of demand for clinical service, it is also necessary to include in the model estimates for requirements arising out of non-clinical functions performed by anesthesiologists. The principal non-clinical functions are related to academic medicine. Measuring the time and human resources devoted to teaching and research are often omitted from estimates of physician requirements. The same is true of administration, whether it is related to clinical practice or academic medicine or professional organizations. Equations used in the model should include non-clinical human resource requirements.

d) Figuring out which health care providers will deliver the demanded health care services at the target date and how many of each kind will be required

In planning the anesthesia workforce, an important task is to apportion the total volume of work in anesthesiology among the different types of provider. In Canada anesthesia services are delivered by specialist anesthesiologists and by some family physicians, mostly in rural areas. A small volume of service is delivered by other specialists such as radiologists, obstetricians, etc. In addition, inhalation technicians help with airways management and in some provinces there are anesthesiology technicians.

There are no nurse anesthetists in Canada at the present time, but that does not mean that programmes to train them could not or should not be introduced. Such specially trained nurses have been functioning satisfactorily in both Sweden and the United States for a very long time, although the role these nurses play in each of their country's health care system is quite different. In one case, nurse anesthetists play a supporting role in the provision of anesthesia services. In the other, they play an independent role. In the context of medium to long term planning, it is possible to envisage the introduction of new types of provider such as nurse anesthetists. However, no plan should be made that assumes a portion of the workload will be performed by a new type of health care provider unless concrete plans, including the guarantee of provision of resources, for the introduction of the new class of service provider, have been made. The literature of workforce planning is crammed with reports on the potential of substitution to diminish the demand for physician delivered services, usually unaccompanied by any commitment to introduce the physician substitutes or to secure the resources to do so, or even to find out if there is an applicant pool for the new educational programmes that would need to be introduced.

The database used to study the work patterns of anesthesiologists (data presented in later sections), includes only services provided by physicians, so it was not possible to study the contribution made to the delivery of anesthesia services in Canada by technicians, but it is possible to measure quite precisely the contribution of physicians other than anesthetists. The database covers **all** anesthesiology services delivered by physicians in the province of Quebec during the course of an entire year, a very large, comprehensive database indeed. As Quebec uses inhalation therapy technicians (inhalothérapeutes), their contribution to the total workload is not known. In any case, the work performed by the inhalation therapy technicians is additional to the work performed by physicians. By necessity, any quantification presented in this paper has to be restricted to physicians, but it should be recognized that this is a deficiency and that this is an area that requires further research.

Based on statistics reported for Quebec and data collected by The College of Family Physicians of Canada, it is possible to obtain estimates of the proportion of anesthesiology services delivered by different types of physicians. These estimates for Quebec for the year 1998/99 work out as follows:

Anesthetists	96.0%
Family physicians	3.7%
Other specialists	0.3%

Because the use of family physicians to deliver anesthesia services varies by province, the role of non-anesthetists in the delivery of care may be far greater or less than it is for Quebec. For example, based on data covering fee-for service billings (excludes work performed by salaried physicians) in 1998 provided by the Ontario Medical Association derived from OHIP billings data, family physicians are delivering approximately 8.8% of physician delivered anesthesia services in Ontario. The role of family physicians in the delivery of anesthesia services is clearly far more of an issue in Ontario than it is in Quebec. It may be of even greater importance in other provinces.

The implications of the above for a planning model are that Quebec might include in its projections, the assumption that family physicians would deliver 2–4 % of the anesthesiology services, whereas Ontario might assume that 7–9 % of services would be delivered by family physicians. Each province would have to come up with a reasonable estimate or a goal.

e) Translating estimates of demand for services into number of physicians required

Once calculations have been made of the volume of services needed and the share of these services apportioned between different types of provider, we are left with the question of how to get from volumes of service to the number of physicians who are going to deliver the services.

We know that physicians do not all work the same number of hours per week or work the same number of weeks per year. We know that men and women have somewhat different work patterns and that older physicians have different work patterns from those of younger physicians. What this means in practice is that depending on the demographic characteristics of the physician population, a greater or lesser volume of services will be delivered. In short, when counting the number of practicing physicians we have a standardization problem, just as was described for the population figures in an earlier section. (This, by the way, is another reason why comparing physician population ratios over time is misleading. Neither the numerator nor the denominator of the physician population ratio measures the same thing over time.)

The simple solution to the problem of translating service volumes into head counts, which consists in assuming a particular workload per physician and then dividing the total workload volume by the specified average workload, to arrive at the number of physicians required is just not accurate enough. It might work satisfactorily if neither the age nor the sex composition of the physician workforce changed with the passage of time or if average physician workloads stayed constant over time. None of these suppositions holds out. The physician workforce is increasingly female; hours worked by physicians, as measured in statistical studies have varied considerably from year to year and are sensitive to incentive and disincentive schemes; the proportion of the physician workforce aged 60+ has been increasing for many years, and these physicians typically reduce their work hours as they get older.

Physician workforce planners cannot control the age at which medical students graduate or enter practice, nor can they determine the sex distribution of entering or departing physicians. These are variables outside their control and must be taken as givens. Thus manipulating the demographic characteristics that influence practice behaviour is not a tool available to workforce planners.

In theory it does not matter whether a society has 60000 physicians working “full-time” or 120000 physicians working “half-time”. Either of these arrangements would result in the same volume of service being delivered. In the case of 120000 half-time physicians, the number of people being served per physician (i.e., the PPR) would be only half what it would be if the same population were to be served by 60000 full-time physicians. It is extremely important to remember this when physician numbers are being compared over very long periods of time. Like is often not being compared with like.

In order to overcome the problems posed by differing work practices among physicians a standard accounting unit for measuring physician workload has to be found and very often a calculation of full-time equivalents (FTEs) is used. Alas, there are a number of difficulties with the use of FTEs. Only the most serious are mentioned here because otherwise some readers will wonder why FTEs, as they are usually measured, were not suggested for incorporation into the model.

First of all, the most commonly used measure of full-time in workforce planning in

Canada is not an absolute measure but a relative one, and is based on ranges rather than fixed norms. The National Physician Data Base (NPDB) uses an FTE based on earnings. All physicians who earn below a given percentile of all physicians' earnings are designated as part-time; between certain percentile earning ranges they are considered full-time; above a specified amount, they are considered equivalent to more than 1 physician, with fractions such as 1.2 depending on earnings. This may have some utility in summarizing differential amounts of work done by physicians in a single year, but it is not useful for physician manpower planning and hence cannot be recommended as a tool in the planning model. Relative measures are unhelpful because the definition of full-time depends on the average amount of work done by physicians in that year only. There is no way to convert any given volume of work ***by a constant*** to derive a head count of the number of physicians required to deliver services calculated on the same basis from year to year. Using the NPDB's definitions, next year's full-time physician may be delivering more or less service on average, than last year's physician. The difference may not amount to much in a period of 2 years, but the cumulative effect over the full cycle of a physician planning exercise could be very substantial indeed. The reason for this is given in the next paragraph.

The major problem for a planning model is that distinctions such as "full-time" or "part-time" are just not fine enough. ***The demand for physicians is extremely sensitive, one might even say hypersensitive, to the number of hours worked per week***. Take as an example the impact on physician requirements of each physician working just 1 hour less per week. Let us assume a 48-hour week in a system using 60000 physicians. If on average physicians drop their workweek to 47 hours, how many more physicians do we now need to deliver the same volume of service? With the new 47-hour workweek, the system will need physicians to make up 60000 hours (1 hour lost for each of 60000 physicians). Since on average, each physician will now works 47 hours, the number of additional physicians is 60000/47 = 1272. The large impact of small changes in hours worked is usually ignored in workforce studies and is one of the reasons why, with the feminization of the physician workforce, physician requirements are frequently under estimated. In many jurisdictions in Canada, measured physician working hours have been declining for years.

Another important reason for rejecting or limiting the use of FTEs in planning models is that no human being is a fraction. ***Final physician requirements should only be expressed in whole numbers***. The author of this paper has seen well-received studies in which physician requirements were calculated and expressed as FTEs with no correction to allow for head counts. This is a gross error. There have always been physicians who worked reduced hours and there always will be. It is quite simply wrong to calculate the workload of all physicians in terms of full-time equivalents only. FTE counts are usually in number than the actual head count of physicians delivering service. Unless working part-time is to be banned, obviously unthinkable, FTEs are a meaningless concept when it comes to counting flesh and blood physicians for practice. FTEs are a summary measure of work volume, not a measure of physicians as human beings, which is what we require for planning purposes. If demand calculations are made in terms of FTEs, these counts still need to be translated back into a head count measurement.

To solve the problem before us, we need to start with the expected demographics of the physician workforce at the target date. This means estimating the age/sex distribution of the physician workforce as it is expected to be at the target date. By extrapolating the work patterns of the physician workforce in the base year disaggregated by age and sex, to the expected pool of physicians at the target date, we can estimate the volume of work that might be forthcoming from the physician workforce of the future.

Before concluding this section, it is worthwhile considering types of FTE measurements that could be useful in workforce planning.

As has been stated, definitions of FTEs involving relative measurements are hardly worth the effort. However, FTEs can be defined in absolute terms that do not vary from year to year. For example, 1 FTE could be defined as 40 or 45 or 50 hours of work per week (ranges such as 40-45 hours per week do not qualify as an absolute measure). In such situations it would be possible to work out a formula for converting measured work loads expressed in hours worked, into FTEs. Then, based on the observed distribution of work patterns of physicians, into number of physicians required. The difficulty is that most available measurements of physician workload are made in terms of physician earnings. There are no regularly collected, verified, comprehensive data on hours worked. This is why earnings are used as a proxy measurement for time worked. Because earnings are largely based on amounts billed for services and hence proportional to amount of work done, earnings are a reasonable proxy for volume of work done. The use of data series on earnings as a measurement of volume of work done over time necessitates making adjustments because of wage inflation and related factors.

To overcome these seemingly insuperable problems, it is suggested that the following method be used:

Start in the base period by measuring the volume of services consumed by the population by age and sex. Secondly, using population projections by age and sex, calculate the future demand for anesthesia services, assuming that there is some regularity in the differential levels of consumption of service by age and sex.

More sophisticated models may go beyond mere extrapolation of the situation in the base period and incorporate assumptions about expected changes in how service is delivered and the effects of these changes on the rate of utilization of services by age groups in the future.

Once calculations of future demand for anesthesia services have been made, the simplest method for determining the number of physicians required at the target date, is to calculate the % change in services between the base period and the target date and to assume that the same % change in number of physicians will be required. This is a long-winded way of saying that if demand for service increases 5%, then the number of physicians required will also increase by 5%.

This simple formulation may be a reasonable starting point, but it is also necessary to take into consideration the demographic composition of the physician workforce in the base period and the target date in order to adjust the estimated number of future physicians required in the light of workforce patterns that will result from demographic changes. Examples of demographic change associated with altered work patterns are: a younger physician workforce implies longer average work weeks and consequently fewer physicians required to perform a given volume of work; an older physician work force implies the opposite and a more feminized work force implies shorter average working hours and, by inference, a larger number of physicians to perform a given volume of work. Given the extreme sensitivity of physician requirements to average hours worked, these considerations are not negligible.

It has been shown, depending on the province in question, that non-anesthetists may deliver a greater or lesser proportion of anesthesia services. For family physicians or other specialists who deliver some anesthesia services, anesthesia is rarely their principal field of medical activity. This has implications for the number of such physicians required to deliver a given volume of service. An example using data from Quebec illustrates this neatly. These data come from the database of the Régie de l'Assurance Maladie du Québec (RAMQ) and refer to amounts billed for anesthesia services for the fiscal year 1998/99.

The data reported show the average amounts billed in Quebec by different types of physicians for anesthesia services in 1998/99 and the number of providers who delivered services.

Type of Provider of Anesthesia Services	Number of Providers	Average billings in 1998/99	Total Billings
Anesthetists	529	$188966	$ 99962998
Family Physicians	189	$ 20526	$ 3879454
Other Specialists	156	$ 2232	$ 348148
Total	874	$119211	$104190600

From this table we learn that anesthetists constituted 60.5% of all the physicians who delivered anesthesia services in Quebec, but that they provided 96 % of all the anesthesia services; family physicians constituted 21,6% of all the physicians who delivered anesthesia services and they delivered 3.7% of the services; other specialists although 17.8% of the physicians who delivered anesthesia services, actually delivered only 0.3% of the services.

From these data we can infer that specialists other than anesthetists deliver anesthesia services only on a very episodic basis. However, family physicians, who provide much-needed anesthesia services in rural and low population areas, are required in far greater numbers than would be supposed by looking only at the total amount of service they provide. If concepts such as FTEs were used to calculate the number of family physicians required to deliver anesthesia services, the conclusions reached would be quite erroneous. In the case of Quebec in 1998/99, if $175000 were considered to be the equivalent to the amount earned by 1 FTE, we would conclude that Quebec “needed” 22 FTEs to deliver anesthesia services, although the data show that it took 189 family physicians to deliver the services.

When decisions are made about the provision of slots for extra Post-MD training in anesthesia for family physicians, it is necessary to include in the planning model norms that allow for the fact that anesthesia services will not be the major professional activity of most family physicians delivering those services. In brief, it is necessary to train a relatively large number of individuals to provide a relatively small amount of service.

f) Figuring out how many physicians there would be absent any intervention to change institutions and policies that currently determine physician numbers

In order to work out a plan of action to achieve workforce goals for the target date, we need to have some idea of where we would be if we took no action at all.

The customary way of handling this is to calculate output from medical schools and Post-MD clinical training programmes, make some assumptions about physician immigration and emigration, about retirements, deaths and other reasons for quitting medicine. If planning is at the provincial level, calculations also include internal migration (movement between provinces). Some kind of a balance sheet is arrived at after measuring inflows into practice and outflows, resulting in an estimate of physician supply each year. It is also customary, data being available, to disaggregate physician counts to obtain future estimates of physician numbers by age and sex.

The methodology for obtaining these estimates of future physician supply is elaborated in greater detail in a later section. Here it is necessary to discuss aspects of making supply estimates that lead to errors in the projections

The difficulty arises out of assuming that certain types of behaviour do not change over the life of a planning exercise. Let us assume that we were conducting a projection exercise of the type described in the preceding paragraphs. The statistical data we would use would include:

- A projection of the output of medical schools according to current levels of intake each year
- A projection of the number of graduates of foreign medical schools earning licensure and entering practice in Canada in line with numbers for recent years
- A projection of the output of the different specialty programmes based on the share of each specialty in the number of Post-MD positions in recent years etc.

Projections made mechanically using observed values of the coefficients in the projection model do not take into account society's responses to workforce problems that occur from time to time. A striking manifestation of this is what occurs when a physician shortage is in the offing or being experienced. Physicians and hospitals cannot tell their patients to come back in 10 to 15 years, by which time the institutions responsible for educating physicians will have turned out enough of them to meet the demands of the health care system. Real shortages have to be dealt with immediately. The easiest solution to shortages of physicians is to import them from abroad, thus eliminating the long lead times between the moment of recognition of need and the production of additional physicians. At the time of writing this paper (summer of the year 2000), all over Canada we are witnessing attempts to bring in needed physicians from other countries as quickly as possible. This will, if successful, change the statistical trends showing the number of physicians entering practice in Canada who earned the M.D. abroad.

There are 2 ways to deal with this type of phenomenon in making estimates of what the physician supply will be in the future. The first is to build into the estimates an allowance for increased physician immigration. The second is to do what has already been recommended as an essential feature of quality planning models: regularly update all the coefficients used in the model with the latest available data to reflect changes as they occur. This type of dynamic planning should replace mechanistic extrapolation of past trends indefinitely into the future.

In the short run, it may be difficult to make realistic estimates of the extent of increased licensure of physicians from abroad because the success of recruitment programmes cannot be guaranteed in advance. The regulatory and legal environment surrounding licensure today is such that it may be more difficult than in the past to recruit heavily from abroad.

Let us assume that recruitment abroad is successful, it is easy to conceive of a situation in which governmental authorities finally and belatedly accept the desirability of increasing output from Canadian medical schools. By the time this is done the attempts to deal with shortages through foreign recruitment may have made a dent in the numbers needed from Canadian institutions. Something like this happened following the first major planning exercise of physician manpower in Canada that took place in the ’60s.

The implication of the foregoing for the model for anesthesiology is that the projected supply of anesthetists at the target date should include a grossing up of the numbers to reflect the expected influx of anesthetists from other countries as new paths for the assessing and licensure of anesthetists educated outside Canada are being introduced.

g) Devising a plan and implementing policies to reconcile supply at the target date(s) with demand

The processes described in the previous sections will generate two independently arrived at estimates or ranges of estimates. The first estimates will be of the number of physicians required at the target date. The second will be of the number of physicians expected to be in practice at the target date. The difference between these two sets of numbers will indicate whether there will be a surplus, an approximate balance or physician shortage at the target date and provide magnitudes so that the seriousness of the situation can be assessed. (The expression “range of estimates” appears here although, in order to keep the text as simple as possible, the use of ranges has not been raised so far. Most estimates can be, and usually should be, expressed as ranges. When a model is set up and programmed, it is much easier to incorporate ranges into calculations. An example of expressing coefficients in terms of ranges is “if immigration into Canada is between 100000 and 150000 persons per year”, rather than assuming a point estimate of, say, 125000 a year. Using range formulations results in a range of possible outcomes rather than a single possibility.)

Once the operation of the model has led to a conclusion that there will be either a balance or surplus or shortage of physicians at the target date, decisions must be taken as to how to mould the future in the desired direction. This phase of operations might be designated as the “plan” and will inevitably involve political considerations that will bring into play provincial and federal governmental authorities as well as the national and provincial educational and medical professional bodies.

Available responses may include increasing or decreasing medical school enrolment, increasing or decreasing the provision of specialty training opportunities, encouraging substitution of some types of service providers with other types (not by talking about it, but by actually doing it), encouraging or discouraging physician immigration, etc. In any case, the part played by the modeling process will be taken over at this stage by policy making. The model may help in simulating the results of proposed solutions, in order to encourage the use of effective decision making, but models are only mechanical number crunchers. They only spew out what has been programmed into them. It is for the political establishment to make policy respecting future physician supply and how to achieve workforce goals.

Because of the complicated, should one say internecine, nature of the politics involved in physician resource decision making, it is extremely important that contributors to the planning model include professional medical associations, provincial governments, medical schools and health administration academics. Only if all these parties agree on the values of the coefficients used in the model at the input stage will they agree with the results generated by the model. Only if that consensus exists, will rational decision-making follow on conclusions arrived at from the modelling process.

The College of Physicians of Quebec has been operating a physician planning model for many years now. One of its greatest benefits derives from the cooperation and input of all interested parties, so that despite a divergence of interests among many of the parties involved, at least there is no longer suspicion about the validity of the numbers entered into the model or the projections emanating from the model. This situation was not achieved overnight, but only after years of cooperation. Unfortunately, a similar situation does not yet exist in the rest of Canada, as has so amply been demonstrated in recent years when medical associations claimed that physician shortages were imminent whereas governments, based on advice from academics that was not derived from quantitative studies or modelling of any kind, claimed that there were too many doctors.

The cooperative work environment in which the Quebec model is run can lead to rapid decision-making and implementation. This is not meant to suggest that physician work force issues have been depoliticized in Quebec. That would be expecting too much. But it does mean that the parties to decisions, including the provincial government participants, are generally well informed and relatively sophisticated users of the data. This was illustrated a few months ago when the government of Quebec was the first jurisdiction in Canada to reverse the decisions to reduce medical school enrolment made following implementation of the Barer-Stoddart recommendations. Starting in the autumn of 2000, intake into Quebec medical schools will be increased substantially.

To conclude this section, a planning model can be a very useful tool for those who have to plan the physician workforce. Because of the long lead times in producing results from changed physician workforce policies, problems have to be anticipated and solutions implemented years before the problems actually appear. This necessitates having reliable projections. The time to increase medical school places is years before there is a manifest physician shortage. A good model can help, but only if all parties agree on its utility. The best model in the world will be of little practical utility if the authorities that have to take decisions pay no attention.

6) Technical and Analytical Considerations

This section deals with definitional and statistical desiderata for operating a physician workforce model for anesthesiology. It includes some analytical information that provides the rationale for the specific methods recommended for dealing with physician supply issues. A glossary of definitions is provided to eliminate some common misunderstandings of terminology and jargon used in the presentation of physician workforce analyses.

This section starts with the important concepts, stocks and flows, as they pertain to physician work force planning. These concepts are essential to clear thinking and the analysis of workforce phenomena.

a) distinguishing between stocks and flows

Anyone who has read even a small fraction of the literature related to physician workforce planning has encountered authors' frustrations at finding conflicting statistical data related to physician numbers. In particular, individuals close to the practice scene often observe that the number of physicians in practice differs from the reported statistics, sometimes considerably. Here we will concern ourselves with some of these discrepancies.

Often misunderstandings about the numbers arise out of not making distinctions between stocks and flows.

The two principal physician databases in Canada, those of the Canadian Medical Association (CMA) and the Canadian Institute for Health Information (CIHI), give physician counts for a precise day of each year. As it happens, the days are just 1 day apart. CIHI reports physician numbers as of 31 December each year and the CMA as of 1 January each year. This in itself gives rise to some confusion because the data are to all intents and purposes reported for the same time point, though the year for which data are reported is not the same. Physician counts reported for 1999 by CIHI (data as of 31 December, 1999) are reported for the year 2000 (data as of January 1, 2000) by the CMA. Anyone wanting to combine in a single study data from these sources always has to make sure that the correct years are compared. Such details, however, are not the main focus of this section.

The main focus is noting the difference between counting physicians at a particular moment in time, which can be likened to taking a snapshot, and counting physicians over an entire time period, which can be likened to making a movie.

What does it mean when the CMA, for example, says that it is reporting the number of physicians on a specific date? Was a census conducted on that date?

These questions take on meaning when we recognize that doctors may enter or leave practice on any day of the year. There is no such thing as a static physician count, just as there is no such thing as a static population count. Yet, all the most common, widely used statistical data series are a set of snapshots purportedly taken on one particular day each year. The "snapshot" referred to here is not an annual census of physicians, but rather a count of the number of active physician records in the physician database on the day of the year on which the file is "frozen".

All year long, keepers of databases receive information about physician arrivals and departures, the issuing of licences to practice medicine, movements abroad, retirements, specialty certification examinations, etc. As information becomes available either new physician records are created where none existed before, or records are updated, or records are deleted.

On the day of the year when physician records are counted for statistical purposes, the entire physician file is frozen. Very simply this means that no more changes are made to the frozen in time version of the physician database and this version is used for generating statistics. The new snapshot taken on the day the file is frozen reflects all the changes that have been made to records in the database during the year that has elapsed between the taking of the previous photograph.

Two aspects of this method of generating physician statistics are relevant to workforce planning models. The first aspect has to do with data quality and the second to understanding stocks and flows for the purpose of workforce planning.

With respect to data quality, the point to remember is that the method by which physician records on a database are updated is by database managers learning of changes and then recording them. An event is recorded on the file, only if and when the database managers learn about it. There is inevitably a delay in learning of certain types of events such as a physician's retirement from practice or move from one geographic location to another, especially when the move is to another country. Not infrequently database managers never learn about a relevant change or addition that should be made to the database. (For example, the CMA database has a category for physicians who were known to be in practice, but whose current location or professional activities they were unable to ascertain. Not knowing where the physician is or what s/he is doing means that no reason can be assigned for the departure of the physician from practice. This category is called "removed" and at any time there are thousands of physician records dumped in the removed category). Needless to say, the very real difficulties involved in constantly updating physician files means that the quality of the data related to changes from year to year leaves something to be desired.

Over the years, long experience studying these types of data has shown that official statistics generally undercount movement of physicians abroad and are slow to record the entrance into practice in Canada of physicians from abroad. In general, events are recorded, not when they occur, but when the database managers get wind of them. This may be a long time after the events actually occurred. It has not been the practice to back date events to the time they took place because this would mean that statistical series for earlier years had to be constantly revised to reflect the back dated changes to records. Naturally, statistics derived from database files can only reflect what is on the file at the time of the snapshot. Any inaccuracies in the file are captured in the snapshot also, and affect the annual statistics generated from the file.

The count of physicians obtained on the day the snapshot is taken is referred to as the stock of physicians on that date. All comings and goings during a year constitute the flows into and out of practice. New entrants into practice or physicians returning after an absence from practice constitute flows into the system and add to the physician stock; leavers for any reason such as death, retirement, emigration, constitute flows out of the system and diminish the physician stock.

The principal reason for drawing attention to the distinction between stocks and flows is that ***planning the physician workforce is about influencing and determining the magnitudes of flows***.

Nearly all planning policies involve managing the size of flows. Planners either want to increase physician numbers, keep them stable or reduce them, or they want to influence the locations in which physicians practice or the specialties they choose. These are all flows of one kind or another.

A characteristic of flows in the physician workforce is that, in any one year, they constitute a relatively small % of the total stock of physicians. Below is an example of statistics showing stocks and flows of physicians taken from data published by the Ontario Physician Human Resources Data Centre (OPHRDC) for the year 1998:

Ontario Physician Flows 1997 to 1998 (1065 kb)

The chart shows the stock of physicians in the years 1997 & 1998 and accounts for the difference between the two numbers in terms of the flows into practice and out of practice. The figures are:

In 1997 there were 20133 records on the OPHRDC file
In 1998 there were 20265 records on the OPHRDC file
Net change = +132

The addition of 132 persons to the Ontario stock of physicians between December 1997 & December 1998 could have come about in a large number of different combinations of flows into and out of the system. In fact, the flow chart shows that there were:

880 additions to the stock over the 12-month period
and 748 subtractions over the 12-month period
Net change = +132

Now, 748 departures/flows out of the system during 1998 out of a physician stock of 20133 represents only 3.7% of the 1997 stock; 880 additions/flows into the system during 1998 represents only 4.3% of the Ontario physician stock of 20265 physicians as of December 1998. These figures are in no way exceptional as the turnover of physicians, either into or out of the system, typically amounts to less than 5% each year.

The implications of this is that ***it is extremely difficult to make large changes to the stock of physicians in a short space of time***. A vivid example of this is the current generalized shortage of physicians in Canada. For years provincial governments were advised that Canada had too many physicians, a conclusion reached without studying and understanding the magnitudes or sources of flows into and out of the health care system. Only the difference between the stock numbers were analyzed yearly, with little or no attention paid to why or
how stocks changed each year. Analysis was often restricted to statements such as "the number of physicians increased more rapidly than the population", a conclusion that can be reached merely by comparing stocks from year to year without finding out why or what factors were contributing to observed rates of change. The dynamics of physician supply, i.e., the components of change, the flows into and out of the system, are the keys to understanding what is happening in health care supply. Without studying the dynamics, we don't know if additions to supply are increasing or exits from the system are decreasing or what combination of these is bringing about increasing physician supply. The converse is true when physician supply is decreasing.

Physician planning should not be based only on comparisons of physician supply year to year. This is because the levers of action available as policy tools, as has already been mentioned, are almost exclusively components of flows. It is necessary to have accurate and timely measurements of the flow variables. For this reason, the equations suggested in the supply side of the planning model heavily stress measurements of flows. The currently available statistics for several of these variables are often not of a high quality. Some of the reasons for this have been touched on earlier in this section. Some relevant flow statistics barely exist at all. However, if planning models are to be a useful tool, projections parties could lobby for an improvement in the statistical series that measure flows)

b) supply module, description & summary

To produce projections of physician supply, the suggested planning model should include an annual accounting of physician numbers arrived at by computing flows into the health care system and flows out of the health care system the flows being the mechanism by which physician supply changes. The proposed annual accounting relies on the most elementary arithmetic.
The basic equation states that the number of physicians in time period 2 is equal to the number of physicians in time period 1 plus new entrants, minus departures.

$Pt_2 = Pt_1 + Add - Dep$

Where:

P = stock of physicians

T_1 = time period 1

T_2 = time period 1 + 1 year

Add = additions to the stock between t_1 and t_2

Dep = departures from stock between t_1 and t_2

We have started our annual accounting of physician supply with 3 numerical quantities:

- The stock or supply at the beginning of the accounting exercise.
- The number of new entrants into practice between the two time periods (which will almost always be of 1 year's duration).
- The number of departures from practice between the two time periods.

How do we obtain the statistics to perform the necessary arithmetic operations? We will deal with each of the 3 required sets of data one at a time.

The stock of physicians/anesthetists

There are a number of different statistical series, regularly published, giving the stock of anesthetists each year. By now, it should be clear that the number of physicians at any one point in time is not the same as the number of physicians who have practiced medicine during the course of a year. For many purposes, it is necessary to include in computations, all physicians who have practiced during the course of a year. This figure differs from a stock computation in that it includes all physicians active at the start of the year as well as all newcomers who became active at any time during the course of the year, i.e., Pt_1 + Add. These definitional matters are relevant for the planning model because data related to the consumption of physician services usually cover physician services delivered over the course of an entire year, not a single point in time. Naturally, services delivered over a full year are delivered by physicians who practiced at any time whatsoever during that year, no matter how short.

Reference has been made to some of the problems with data quality, but at least it is possible to obtain basic stock counts. Users of the data should keep in mind, however, that physician counts derived from service delivery statistics over the course of a year will not be identical to measurements of stocks of physicians. Because physicians delivering service over a year are taken from the 1-year movie rather than from a single snapshot taken on one day of the year, the count based on services is invariably larger than the stock measurements.

Additions to the stock

Additions to the stock need to be categorized to distinguish different sources of entry. Each source should be identified and regular statistics obtained to monitor trends in each of the components separately.

The additions to stock should be disaggregated in several different ways:

a. Source of addition - geographic
b. Source of addition – educational background
c. Whether first-time entrant into practice or re-entrant or migrant
d. Year and province in which license to practice in Canada was first obtained

The geographic criteria include province or country of location prior to being recorded as a new entry on the physician database. It should be possible to distinguish between physicians migrating from within Canada and physicians coming from abroad

The educational criteria should include the medical school/university and country in which the physician earned the MD or equivalent first professional degree in medicine. The other important educational variables include Post-MD clinical training history, especially specialty certification, if any, and the year and field(s) of certification. Since 1988, the Canadian Post-MD Educational Registry (CAPER) has collected and maintained extremely accurate and detailed data on these matters for all trainees in Canada. Since most additions to stock are recent graduates, at least in this area good data are available.

The output of medical schools and the output of training programs are the principal sources of Canada’s physician supply. Altering the numbers emerging from M.D. and from specialty training programmes are the prime policy tools available to planners. Thus, the educational breakdowns of the statistics related to annual additions to the stock are indispensable data elements of a good planning model.

A further set of distinctions is important when categorizing annual additions to stock. These distinctions have to do with whether an entering physician is a first-time entrant or someone who has moved from another jurisdiction in Canada or who has returned to practice after an absence of 1 or more years.

The following remarks refer to data collected within a single province. When a physician moves from one province to another, the physician numbers of both provinces are affected. One province has gained a physician and one province has lost a physician. When compiling national statistics these gains and losses balance each other and statistics are not affected. Not so for provincial data. For several Canadian provinces, out-migration of their physicians, not only to other countries, but also to other provinces, may be the largest component of outflows. For the receiving province, a gain is a gain and where the physician came from may not seem important. For planning purposes, it is. ***Only first-time entrants into practice are true additions to stock***. Physicians moving from other provinces or returning from absences of more than 1 year's duration are not new physicians to the health care system as a whole. To know the rate at which the entire system is producing truly first-time additions to the physician stock, it is essential to be able to identify all those physicians who have never been licensed or practiced medicine in Canada before. If readers think in terms of cohort analysis, this point becomes immediately obvious. (For an illustration of cohort analysis and its relevance to planning models, see the next section.) Data on physicians by year of first license in Canada could be forthcoming regularly from licensing authorities, but to date they have not. The ideal solution would be for the major national and provincial physician databases to include the year and province or territory of first licensure as a basic variable in their databases just as they record other relevant educational and certification data.

Recording the year of first obtaining a license in the province of current practice is not adequate. It is necessary to check and record whether a license was held in earlier years in any other Canadian jurisdiction.

The equations to be used in the annual accounting are given for national totals. For provincially based planning, the internal migration numbers must be added into the equations.

The definitions to be used for the ADD component of the annual accounting are:

$$ADD = FST_e + RET$$

$$FST_e = FST_eGOCMS + FST_eGOFMS$$

$$RET = RET_{for} + RET_{ed} + RET_{mat} + RET_{sl}, \text{ etc.}$$

FST_e = first-time additions to stock,

RET = returnees after absence of at least 1 year

FST_eGOCMS = first-time additions, graduates of Canadian medical schools
FST_eGOFMS = first-time additions, graduates of medical schools outside Canada
RET_{for} = returnee from temporary absence abroad
RET_{ed} = returnee from educational leave
RET_{mat} = returnee from maternity leave
RET_{sl} = returnee from sick leave

Departures from the stock

Departures from the stock need to be categorized to distinguish different reasons for departure. Each reason should be identified and regular statistics obtained to monitor trends in each of the components separately.

The departures from the stock should be disaggregated in several different ways:

a. Whether departure is temporary or permanent
b. Permanent departure by reason
c. Temporary departure by reason

The reason for distinguishing temporary from permanent departures is that temporary departures are not losses to the health care system in the same sense as permanent departures. Allowing for a time lag, the number of temporary departures and the number of physicians returning from leaves of absence will balance each other. A permanent departure, however, has to be replaced, and just as first-time entrants are the accurate measurement for the rate at which new physicians are entering the health care system, so too are permanent departures the accurate measurement of the rate at which physicians are exiting it.

Planning policies will almost certainly vary depending on the reasons for physicians leaving. Planners are faced with a very different situation in which many physicians quit practicing medicine before their expected age of retirement compared with one in which they quit at or around the expected age of retirement.

Projection models are pretty accurate in estimating future levels of retirement, because they are projected on the basis of age and behaviour related to work patterns by age, which do not fluctuate erratically. However, levels of emigration, for example, can change quite suddenly. During the decade of the nineties, Canada experienced a large, unexpected emigration of physicians to other countries. The rates of emigration were well in excess of customarily observed levels, clearly an indication of some malaise in the system that needed fixing.

In order to understand what is driving levels of departure of physicians from the health care system, statistics on departures need to be disaggregated by reason of departure.

The reasons for permanent departure include death, retirement, debarment from practice, career change, permanent emigration to another country, sickness or invalidity, etc.

It may not always be possible to determine for certain whether a departure is permanent or temporary. This applies particularly to physicians who have moved abroad. When making projections, it is customary to adjust figures to assume a time-lagged rate of return of a % of physicians who have moved abroad. Making realistic assumptions requires a monitoring of statistics on returnees so that such estimates can be sufficiently accurate.

The reasons for temporary departure are the same as those listed for returnees from a temporary absence of at least one year: educational leave, maternity leave, sick leave, temporary movement abroad, etc.

The equations for departures from the stock of physicians look very much like the equations for additions to the stock of physicians except that they substitute the items described above for those used for additions to the stock.

Socio-demographic variables

All the component variables involved in the annual accounting of physician supply should be disaggregated to show:

a. The age distribution
b. The sex distribution
c. The medical school of graduation or country, if not Canada
d. Specialty of training
e. Year of medical school graduation
f. Year of specialty certification

Since most data involved in physician workforce planning come from the principal national or provincial databases and the variables listed above are standard variables carried on each physician, this is not quite as onerous as it might appear. The reasons for including these variables have been given elsewhere so they will not be repeated here.

Educational variables

For many years provincial governments have declared that Canada should be self-sufficient in the production of physicians for the health care system. For this to be feasible, Canadian educational institutions must educate the “right” number of physicians and then allocate specialty training opportunities in such a way as to produce a desirable distribution of different types of specialists. In the previous section, we discussed the role of the flow of first-time entrants into practice each year as the key indicator of the rate at which the physician workforce is renewed, expanded or contracted. As the single, most critical factor regulating and determining the magnitude of the physician workforce, the output of Canadian medical schools is of central importance in physician workforce planning. The planning model must reflect this.

The equation for annual additions to stock contains a term that divides first-time additions into graduates of Canadian medical schools or graduates of foreign medical schools. Special attention needs to be paid to generating the numerical values entered into the equation for graduates of Canadian medical schools. It is best to think in terms of cohorts of entrants into medicine and how output varies with variations in the number of students admitted to medical school. A key policy-planning variable is setting the number of medical school places.
For planners interested in a specific specialty, the chain of consequences following from setting the quota of medical school places in Canada can be examined in cohort terms. The example shows how the output of anesthesia programmes might vary depending on the inputs into medical school 9 or more years earlier, with medical school entry cohort sizes of either 1500 or 2000 or 2500 students.

Annual number of medical school places	**1500**	**2000**	**2500**
If 97% of students earn M.D. degree	1455	1940	2425
If 98% of graduates enter Post-MD training in Canada	1426	1901	2376
If 95% of trainees complete training in Canada	1355	1806	2257
If 4% of trainees complete anesthesia training	54	72	90
If 5% of trainees complete anesthesia training	68	90	113

The transition rates used in the above illustration are not atypical and they illustrate several points relevant to planning and models for workforce planning.

a. A cohort of entrants to medical school can never be increased or decreased retrospectively. There is no going back on mistakes in setting admission levels to medical schools.
b. The output of medical schools is not the same as the input. Output can never exceed input, as there will always be some dropouts, failures emigrants, people who reconsider their career choices. Careful selection of medical schools can reduce dropout rates but it is impossible to eliminate them altogether (and quite undesirable). Although the example shown above uses constant dropout rates for 3 different levels of admission to Canadian medical schools, in fact as the number of students admitted increases, other things being equal, dropout rates will probably increase also. This is because as the number admitted from an applicant

pool increases, selectors go lower down the selection list to fill places. Planners need to keep an eye on completion rates of M.D. programmes especially at a time when numbers admitted are on the increase as they are about to be in Canada.

c. Just as there is some seepage from entry to medical school to graduation, there is some further seepage between graduation and entry to clinical training programmes leading to certification and licensure. By the time would-be physicians enter clinical training programmes, the entry cohort has been diminished by approximately 5%. Once specialty training has started, some trainees will not complete training or move abroad prior to completing training.
d. Current observations suggest that approximately 4½ % of Post-MD positions are in the specialty of anesthesia. The table shows the output from anesthesia programmes if 4% or 5% of completers qualify in the specialty of anesthesia. The figures are meant to drive home the point that those concerned with any specific specialty should concern themselves also with the entire system of which their specialty is a part. It is possible for a short period of time for some specialties to rely on reallocations of positions from one specialty to another, but over the long haul, the system must be geared to providing adequate output from medical schools to feed into the number of positions required by all specialties. In a following section, estimates of demand for anesthetists will be made. At that point it will be possible to assess which level of admission into medical schools is compatible with meeting the future need for anesthetists.
e. Finally, from entry to medical school to completion of specialty training and certification, the process of educating an anesthetist in Canada takes a minimum of 9 years.

There are other aspects of the educational variables that have relevance for the planning model. For example, the age at admission to medical school determines the age of graduation and the age at which specialty certification will be achieved. The age at which certification and licensure are achieved impact on the total remaining duration of professional life, i.e., the number of years of service to the health care system that starting physicians can be expected to contribute. It is well known that today's medical graduates are several years older at the time of graduation than they used to be. This has implications for the rate at which physicians need to be replaced. Statistics on age at graduation and age at completion of specialty training should be included with the data on medical school and specialty training programme enrolments. With specific reference to anesthesiology training programmes, statistics on sources of entry to these programmes should be maintained showing numbers entering by country in which medical degree was earned, by numbers changing career choice after commencing training, by numbers entering after switching from other training programmes. In particular, the numbers starting training in anesthesiology after being in practice for a while should be monitored. Traditionally, anesthesiology has recruited a relatively large share of its trainees among physicians who have already been in practice. Noting the age at which certification is achieved as a factor in the length of professional life, a specialty such as anesthesiology that recruits heavily among physicians from other countries or among those who have already spent several years in practice prior to training will have a fair proportion of its entering physicians starting practice in anesthesiology at ages above 35 or even 40 years of age. The implications for planning are obvious.

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Summary of Demand Module

The demand module calculates demand for anesthesiologists at the target date(s) in two stages. Stage one calculates the demand for anesthesia services. Stage two translates the demand for services into the number of persons, anesthesiologists, who will be required to deliver the services.

Stage 1	Stage 2
Step 1. Calculate consumption of anesthesiology services by age and sex of the population. Calculate differential rates of utilization by type/value of services consumed. **Step 2**. Apply utilization rates by age/sex, as calculated in step I, to target date(s) population to obtain the unadjusted demand for anesthesia services at the target date(s). **Step 3**. Should current rates be adjusted? e.g., reduction in use of certain types of surgery? (Impact of	**Step 1**. Who will deliver anesthesia services? Anesthetists Family Physicians Other health care workers… (Inhalotherapists, Anesthesia technicians, Nurse anesthetists?) **Step 2**. Allocate services to different types of health care workers and arrive at the share of services to be delivered by Anesthetists. **Step 3**. Make adjustments for activities other than service delivery: Academic

introduction of non-invasive procedures and surgery) Increase in use of certain types of service? (Impact of introduction of new types of surgery and emerging fields of practice such as pain management). Impact of organizational changes including substitution, increased efficiency? Can any of these factors be quantified? Result of steps 1, 2 & 3 will be a projected demand for anesthesia services at the target date(s).	requirements for research & teaching;Administration and any other non-clinical professional activities. **Step 4**. Determine how many anesthetists will be require to deliver the workload assigned to anesthetists. Use statistics on work patterns by age and sex, age at certification, expected duration of professional life, etc., to derive a head count of anesthetists required at the target date(s).

Supply Module at a Glance

The method suggested for estimating supply at the target date(s) can be used both for estimating what the supply would be absent intervention in the system and for simulating the impact on future physician supply of altering the coefficients of the variables determining future supply. Simulation exercises are useful in trying to figure out what the impact of various policy options might be in trying to solve workforce problems.

Summary of Supply Module

The supply is calculated through a system of annual accounting, which starts with a count of the number of physicians, the stock, in the base year. The number of physicians 1 year later is computed by adding inflows to the stock and subtracting departures that occurred at any time during the date of the base year physician count and the same date of the year, but 1 year later. The supply in the base year + 2 years repeats the accounting, but now starts with the physician count in the base year + 1. This process is repeated until physician supply at the target date is arrived at.

Definitions:

Supply in Base year	= stock of physicians on count day of the year
Supply in Base year + 1	= stock of physicians in base year plus inflows (ADD), minus departures (DEP), between the two dates
FIRST-TIME entrants	= first-time GOCMS (graduates of Canadian

	medical schools) + first-time GOFMS (graduates of foreign medical schools)
RE-ENTRANTS	= returnees from abroad; from maternity leave; from educational leave; from sick leave, etc.
DEP	= PERMANENT DEPARTURES + TEMPORARY DEPARTURES
PERManent departure	= physicians quitting due to death, retirement, debarment, career change, permanent emigration, etc.
TEMPorary departure	= physicians interrupting practice due to educational or maternity or sick leave or temporary movement abroad, etc.

All statistical series should be disaggregated to show:

Age distribution	Sex distribution
Country/medical school of graduation	Year M.D. or equivalent degree earned
Specialty of training	Year of specialty certification

GLOSSARY/TERMINOLOGY : Definitions	
Additions	Number of physicians entering practice between 2 time periods: physicians not active in time period 1, but active in time period 2.
Anesthesiologist, Physician	Refers specifically to a person, the physician or anesthesiologist, who delivers health care services or performs other medical, professional duty.
Certification,Certifying Body	Refer(s) to the qualifications earned following Post-M.D. training in family medicine or one of the specialties. Certification in Canada is awarded, not by a university, but by either the College of Family Physicians of Canada, the Royal College of Physicians and Surgeons of Canada or the College of Physicians of Quebec.
Demand	Number of physicians required.
Departures	Number of physicians exiting practice between 2 time periods: physicians active in time period 1, but not active in time period 2.
First-time additions	Additions to stock who have never been active/in practice in Canada before.
Flow	Movement of a physician into or out of practice between 2 time points. A physician who either entered or departed

	the health care system during a year.
Health care service Anesthesiology service	Refers to a health care service or act delivered by a physician or by an anesthesiologist or by any other health care worker.
Licensing Authority	Refers to the College(s) of Physicians and Surgeons of the provinces and territories of Canada, which have the legal right to grant licensure to practice medicine within their boundaries.
Licensure	Refers to the permit enabling a qualified physician to practice medicine in one or more jurisdictions in Canada.
Medical school and/or country of graduation	Medical school of graduation refers to the university awarding the M.D. or equivalent first professional degree in medicine, or the country in which this degree was earned. Unless stated clearly otherwise, it does not refer to the university in which specialty certification was achieved, or to the university in which any other type of degree or qualification was earned.
Permanent departure	Refers to physicians who have exited the health care system with no expectation that they will ever return to active status/ practice. Permanent departures include, but are not restricted to physicians who have died, retired, become too sick or disabled to work, been debarred from practice changed careers, moved abroad permanently.
Population	Refers to the number of people resident in a given jurisdiction on a given date.
Post-M.D. Training	Refers to the clinical training taken following the receipt of the M.D. or equivalent first professional degree in medicine enabling the trainee to qualify as a generalist/family physician or as a specialist.
Re-entrant	Refers to a physician added to the stock between 2 time points who had been temporarily absent from practice for at least 1 year.
Stock	The number or supply of physicians on a given, precise date or point in time.
Supply	Number of physicians available.
Temporary departure	Refers to physicians who have exited practice but are expected to return at some future date. Temporary departures include, but are not restricted to, physicians interrupting practice for educational reasons, for maternity leave, for sick leave, moving abroad temporarily.

Ryten Report

7) Putting Theory Into Practice: Projecting Future Demand

No matter how elegant a theoretical model may appear, if it cannot be operationalized, it is of little practical use. This is one reason why although there are superior theoretical models that could be envisaged than the one suggested in this model, such as basing all future supply estimates entirely on cohort analysis rather than annual accounting, an absence of data would mean not much could be done to put the model to work.

This half of the report will try to illustrate many of the steps and stages suggested in the theoretical outlines provided in the first half. In particular, an attempt will be made to illustrate more convincing techniques than have usually been used in the past, for making projections of future levels of demand for physician services.

The data and conclusions reached from the data, it must be stressed are illustrations. A working model is a continuous and continuing process. There is no substitute for regular monitoring, which by definition, these one-time sets of data and calculations, are not. However, they could be considered a starting point.

Data Sources and the RAMQ billing system

The statistics used in the remainder of this paper come from a wide variety of sources. All the statistical tables report the source of data used. The source is reported directly on the statistical table, space permitting. Otherwise, data sources are reported in the text with the description of the table's contents. However, there is one extensive data set used that requires a more detailed description than just giving the source. The data in question are those that describe what anesthetists do. In the data experimentally produced for this report, projections of future demand are based not on some generalized measure of demand for physicians, but rather on the projected demand for that particular sub-set of health care services that is delivered by people uniquely trained as anesthetists.

How can we isolate and measure from the totality of all health care services those that are delivered by anesthetists and rarely, if ever, delivered by any other kind of physician? The solution to this problem was to use the fee-for-service billing system to isolate the medical acts performed by anesthetists and to quantify how much of each kind of service was consumed by different segments of the population. The same billing system was used to find out which other types of physicians delivered services typically delivered by anesthetists and what proportion of total anesthesia services these other physicians delivered.

The data were derived from the Quebec health care system's data for the 1998/99 fiscal year. On the basis of a special contract, the Quebec billing agency, the Régie de l'Assurance Maladie du Québec (RAMQ), generated statistics on the services delivered by anesthetists over the course of two entire years spaced 10 years apart, 1988/89 & 1998/99. Statistics are available both for the number and type of acts billed as well as the dollar value of the acts billed.

There are literally thousands of different acts that have been assigned codes for the purpose of paying physicians for the medical services they deliver. (The word "medical" is used broadly to include all medical, surgical, diagnostic & therapeutic acts.) The interest in this study was to see whether billing system codes could be used to provide a comprehensive, descriptive picture of the contents of anesthetists' workload and the demographic characteristics of the population served by them. The aim was to classify the very large number of billing codes into a manageable number of statistically useful groupings and then use the classification to generate the desired statistics. With the help of members of McGill University's Department of Anesthesia (See the "Acknowledgements"), the painstaking work of sifting through all the billing codes used in Quebec for billing anesthesia services was completed..

A classification was arrived at which is produced below.

The classification was designed to enable a measurement of the share of surgery, and the different types of surgery, in the workload of anesthetists. The classification also distinguishes between the principal types of non-surgical activities in which anesthetists are involved and makes it possible to get a measurement of the amount of work done in emerging areas such as pain management.

The utility of this type of breakdown in the context of physician workforce planning is that if activity data are measured over a long period of time, it is possible to study trends in the activities engaged in by anesthetists. This is one way to statistically capture changes in the way health care is delivered over time and to incorporate such changes into the projection model. By requesting data from RAMQ for 2 time periods 10 years apart, an attempt has been made to do this, and to see if we can learn anything about trends in the type of services delivered by anesthetists. Trends are useful in refining projection methods, as they should make it possible to identify growing and declining fields of activity and changes in the utilization of services by different segments of the population. As work on a model is continued over the long term, constantly improving the quality of work done through refined projections is a goal to be aimed at.

When work started on this report it was not at all certain that the statistical data requested from RAMQ would turn out to be usable. After all if such valuable data could be obtained with relative ease, why were they not already a standard feature of workforce studies?

In fact, we did encounter a number of practical and methodological problems that had to be overcome in order to be able to use the data for making projections of future demand for clinical anesthesia services. These are described briefly.

In designing the classification to be used in the study, all the codes in use for billing during the years 1997 & 1998 were reviewed. When the statistics for the years 1988/89 & 1998/99 were generated, we discovered that there were a large number of billing codes in use in 1988/89 that no longer existed by 1998/99. This is mentioned for several reasons.

By the time this was discovered it was far too late to undertake the extensive task of looking into the billing codes of 1988/89 to try to establish some sort of equivalence between 1988/89 and 1998/99. This has meant that statistical comparisons of the overall number of individual acts billed in 1988/89 and 1998/99 is not possible. In the statistics presented in this report, comparative data on acts are included only in the field of activity tables in Annex 2. The data on dollar amounts billed by type of anesthesia for the 2 different time periods are comparable.

CLASSIFICATION OF ANESTHESIA SERVICES

Codes	1 Digit Classification
1	Surgical Anesthesia
2	Dental Anesthesia
3	Other Anesthesia
4	Visits and Consultations
5	Not Anesthesia
6	Not Reported

3 Digit Classification	
Codes	**Surgical Anesthesia**
101	CVT Surgery
105	Eye Surgery
110	General Surgery
115	Gynec. Surgery
120	Neurosurgery
125	Obstetrical & rel.
130	Orthopedic
135	Otolaryngology
140	Plastic Surgery
143	Urology
145	Other Surgical

Codes	Dental Anesthesia
201	Dental Anes.
Codes	**Other Anesthesia**
301	Angiography
305	Biopsy
310	Electroconvulsive Therapy
315	Electrophysiology
320	Endoscopy
325	Imaging
330	Insertion/Removal Catheters
335	Obsterical/Non-surgical
340	Pain Control & Management
345	Radiation Oncology
350	Ventilation/Inhalotherapy
Codes	**Other**
401	Visits & Consultations
501	Not Anesthesia
601	Not Reported

The question arises whether amounts billed can be used as a reasonable proxy measure for amount of work done. In setting tariffs for the multitude of different types of service that physicians deliver, two factors predominate: time and complexity. Acts that take longer to perform are paid at a higher tariff, other things being equal, than acts that take less time to deliver. This clearly is an aspect of remuneration that is tied to the amount of work done and, therefore an acceptable proxy for amount of work done. Complex and highly specialized acts are also paid at higher tariffs than more routine types of tasks. In the absence of accurate, comprehensive data on actual hours per week and per year worked, billings data provide a way of measuring the volume of different types of services delivered by anesthetists and of the amount of work done by specific anesthetists. The data are comprehensive, objective (based on administrative records rather than faulty memories) and can be readily compared from one type of anesthesia to another or from one anesthetist to another. As all physicians performing a particular act are paid at the same tariff, we can be pretty certain that differential earnings (physicians' earnings are the sum of billings plus other forms of payment) reflect different levels of activity. If the sum of billings across a large province such as Quebec for an entire year show that amounts paid for the anesthesia involved in eye surgery are higher than amounts paid for urological surgery, we can quite safely conclude that more anesthesia for eye surgery is being performed than for urology.

The serious inconvenience of having to rely on billings as indicators of volume of activity does not come from the fact that they are not good indicators of volume (they are), but rather from the fact that the value of money changes over time. When we compare billings for time periods as far apart as 10 years, it is essential to eliminate from the numbers the amount of increases in costs/expenditures/billings due only to inflation, rather than to genuine increases in activity. In the data presented later in Table 2, 1988/99 billings for anesthesia services were inflated to make the figures reported for 1988/89 comparable with those of 1998/99. The inflator used was the Consumer Price Index (CPI), which had increased 28% between 1988 and 1998 (if prices were = 100 in 1988, they had reached 128 in 1998).

Without performing a separate study to find out whether the CPI was a satisfactory inflator for physician earnings in Quebec between 1988 and 1998, (clearly beyond the scope of this study), one cannot be sure that the comparisons between 1988/89 and 1998/99 are as robust as one would like them to be. For example, there were a number of years during the decade 1988 to 1998 in which physician fees did not increase in line with inflation and were thus below the CPI. Also, financial disincentives of one kind or another were in operation for most of the period in question. How these factors affected physician workforce behaviour and earnings is not known, but it is quite possible that 28% is too high a deflator. This has to be kept in mind when interpreting the data.

Estimating Future Demand for Anesthesia Services in Canada

In this section examples are given of the kind of results that can be obtained by using the methodology suggested for estimating future demand for anesthesia services.

Because of the intrinsic interest in the results not just for Canada as a whole, but for the provinces also, separate demand estimates have been made for each of the provinces. A large amount of number crunching is unavoidable and for this reason, demand estimates were made for one future date only, albeit for 4 different population projections for that date. Once the method is understood and accepted, it is very simple to perform the calculations for any number of time points in the future.

Taking into consideration the points raised in part 5a, “Planning horizons: choosing time-lines”, the target date chosen for the demand estimates was the year 2016, a time point not so distant that the impression is given that nothing needs to be done about the findings, but not so close to the present time that it is too late to do anything to affect the situation at the target date.

The demand projections will be made in stages by examining the various issues that arise in making them. The issues are:

a. Age/sex utilization rates of clinical anesthesia services in Quebec in 1998/99

b. Can we generalize these rates of clinical utilization of anesthesia services to the rest of Canada's population?
c. Can we expect rates of utilization to hold over the entire course of the projection period?
d. Applying the rates of utilization to projected provincial populations in the year 2016.

a) Age/sex utilization rates of anesthesia services in Quebec in 1998/99

Table 1 (below) shows the derivation of the per capita utilization rates of clinical anesthesia services by the population of Quebec in 1998/99.

The population data used are those provided by the billing agency of Quebec, so the numbers differ slightly from official population data. Beneficiary data include all those eligible under the provincially funded health care system at any time during the year. Population data are stock statistics of population counts at a single point in time. (See the discussion of stocks and flows in earlier chapters.)

Population data are shown in 5-year age groups for all but the very youngest and oldest. Babies aged less than 1 year are shown as a group and children aged 1-4 years of age are shown as a group. All persons aged 85 or older are shown as a single category. All data are disaggregated by sex to illustrate varying levels of health care utilization by men and women at different ages.

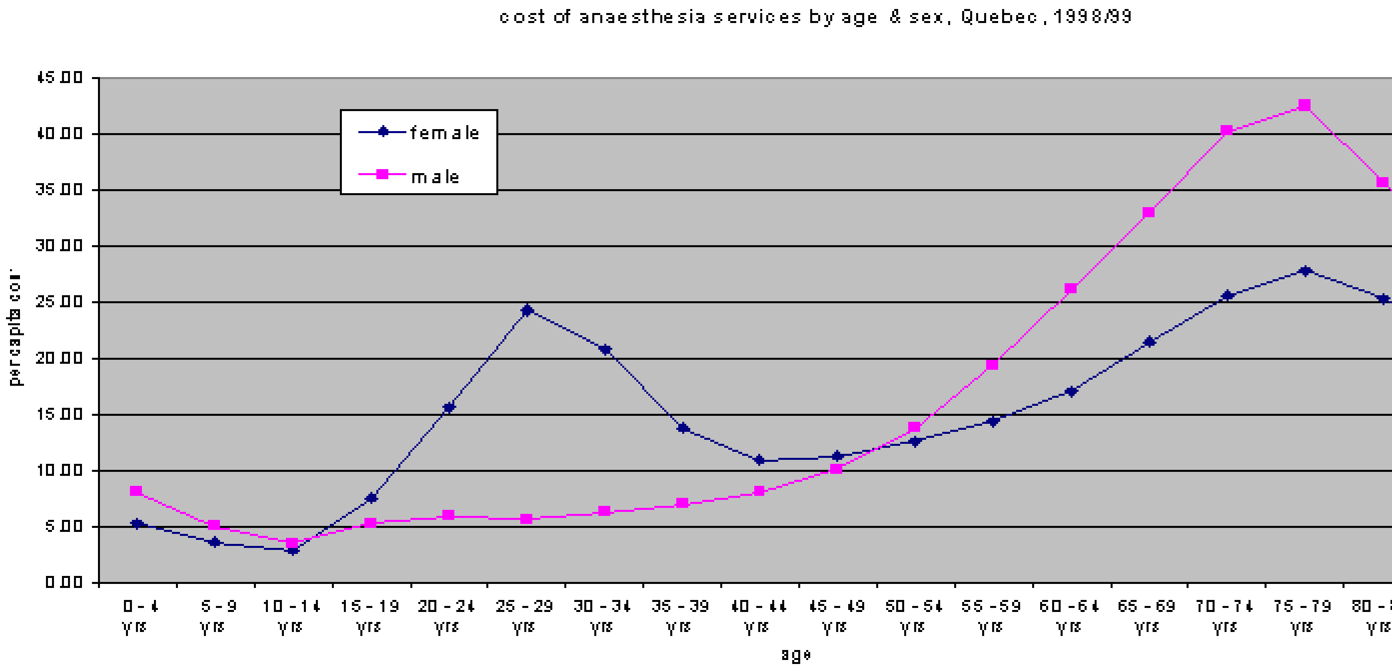
From the data provided by RAMQ, the total amount spent on physician fees in the course of provision of clinical anesthesia services to individuals in each age/sex category is reported. By dividing the amounts paid to physicians for the provision of clinical anesthesia services by the number of individuals in each age/sex category, we can calculate the dollar value per capita utilization of clinical anesthesia services. These calculations are shown in the final column of figures in Table 1.

Table 1
Per Capita Cost of Anesthesia Services by Age & Sex, Quebec, 1998/99

Sex of Beneficiary	Age	Beneficiary Population	$ Amount Anesthesia Services	$ Per Capita Utilization
Female	0	36672	306772	8.37
	1 - 4	173205	837983	4.84
	5 - 9	234843	828327	3.63
	10 - 14	216581	611005	2.90
	15 - 19	235679	1728111	7.54
	20 - 24	230281	3502426	15.64
	25 - 29	229219	5415527	24.30

	30 - 34	279233	5671658	20.89
	35 - 39	324355	4352840	13.80
	40 - 44	313351	3347386	10.98
	45 - 49	277701	3046915	11.28
	50 - 54	245444	3008990	12.61
	55 - 59	192206	2697971	14.44
	60 - 64	159355	2644057	17.06
	65 - 69	155738	3248444	21.45
	70 - 74	137784	3422064	25.55
	75 - 79	107117	2897894	27.82
	80 - 84	71565	1759659	25.29
	85 +	60610	1267794	21.52
Total Female		**3680939**	**50563256**	
Male	0	38133	505666	13.26
	1 – 4	179862	1301842	7.24
	5 - 9	244500	1190413	5.01
	10 - 14	227818	788126	3.56
	15 - 19	245941	1258100	5.27
	20 - 24	229120	1325699	5.95
	25 - 29	225958	1253190	5.71
	30 - 34	278387	1710302	6.31
	35 - 39	323100	2182521	6.97
	40 - 44	312095	2454162	8.08
	45 - 49	274363	2696252	10.11
	50 - 54	242120	3246173	13.79
	55 - 59	187490	3536788	19.40
	60 - 64	147602	3749795	26.12
	65 - 69	135477	4350223	33.02
	70 - 74	105560	4128807	40.22
	75 - 79	68919	2849027	42.52
	80 - 84	37073	1285788	35.67
	85 +	22177	636778	29.53
Total Male		**3525695**	**40398231**	
Not Reported			2663533	
TOTAL		**7206634**	**93625020**	

Per capita utilization rate includes an adjustment to allow for services consumed that were not disaggregated by age of beneficiary. The adjustment distributed services proportionately over all age groups.



Those figures in the final column of Table 1 are the key to making projections of future demand for clinical anesthesia services, as they provide the necessary data for going beyond the use of uncorrected population/physician ratios. The rates reported in Table 1 are crucial to the workforce planning model for anesthesia and because for many, one picture is worth a thousand words (or ten thousand numbers?), the data are shown in graphic form on the next page.

What do these numbers tell us?

There are extremely large differences in the rate of utilization of clinical anesthesia services by both age and by sex. The lowest rates of consumption of anesthesia services are by boys and girls aged 10-14, $2.90 per capita for girls and $3.56 for boys. Even in this low-consuming group, on average boys consumed 23% more services than did girls. The highest rate of consumption of anesthesia services was by men aged 75-79, for whom the per capita rate was $42.52 or just under 12 times as high as the rate for boys aged 10-14. Corollary: It makes an enormous difference to health care requirements, which segments of the population are growing rapidly, and which not.

For women, the childbearing years lead to an increase in the use of anesthesia services in conjunction with surgical and non-surgical childbirth, abortion, sterilization and reproductive healthcare services. The use of these services peaks in the age groups from 20-40 years, with particularly heavy usage among women aged 25-34. Whereas for men, the graph shows services rising very rapidly in the older age groups, for women there is a bi-modal distribution. The graph for women has two peaks, one in the childbearing ages and one in the older age groups. Among the older age groups, the consumption of anesthesia services is considerably higher on average for men than for women. Another interesting demographic phenomenon reflected in these data, well known to actuaries, is the earlier onset for men of the morbidity that leads to increasingly high consumption of health care services. By the age of 55-59, the rate of utilization of anesthesia services by men is already on a rapid upward swing.

Interestingly, these data are an indirect empirical test of the supply theory of demand applied to the specialty of anesthesia. If consumption of services were truly at the whim of physicians, the graph depicting consumption of anesthesia services would not exhibit the shapes that it does. The rates of utilization by age and sex conform neatly and consistently with public health morbidity and related data such as those used by actuaries.)

b) How can we use differential rates of utilization of anesthesia services to make projections of demand at a future date?

Because the sum spent on clinical anesthesia services is a proxy measurement for amount of work done, amounts spent can be equated with number of persons required to provide the services, if we can find a defensible rate at which to make the translation. Discussions with anesthetists in the province of Quebec provided the information that for planning purposes (e.g., deciding the number of positions to be staffed at hospitals) in the year 2000, a guideline was used that equated $180,000 worth of billing with the need for one anesthetist with a full workload. (Readers should keep in mind that this number is based on tariffs prevailing in Quebec and cannot be used in other parts of Canada without adjusting for differences in the level of remuneration in their jurisdiction compared with Quebec.) In arriving at the number $180000, there was concern that the number be set neither too high, nor too low. The opinion was that retention of physicians was best assured in circumstances in which there was a sufficient workload to provide a full and varied practice, but not so much work that over work would lead to dissatisfaction and possibly out-migration as a result.

Since the figure was arrived at after careful consideration in the context of planning staffing levels, there seems little point in re-inventing the wheel, when this useful tool for converting projected demand for clinical services into requirements for full-work load anesthetists is to hand. The only adjustment made to the figure $180000 was to deflate the figure to reflect the fact that the expenditure figures being converted were incurred in 1998, two years earlier than the figure for the year 2000. The conversion factor used in this report is $175000 worth of billings equates with the work of one full-time, full load anesthetist in 1998/99 in Quebec.

Readers should be clear that we are **not** projecting costs. It is future demand for clinical anesthesia services that is being projected. What makes the numbers in Table 1 useful for projecting demand is the relative values of the amounts consumed by different segments of the population. Everybody knows that consumption varies by age, but what we need is a really accurate measurement of the extent of those variations. The rates of utilization, compiled from an enormous, comprehensive, statistically unbiased database provide those relative differentials.

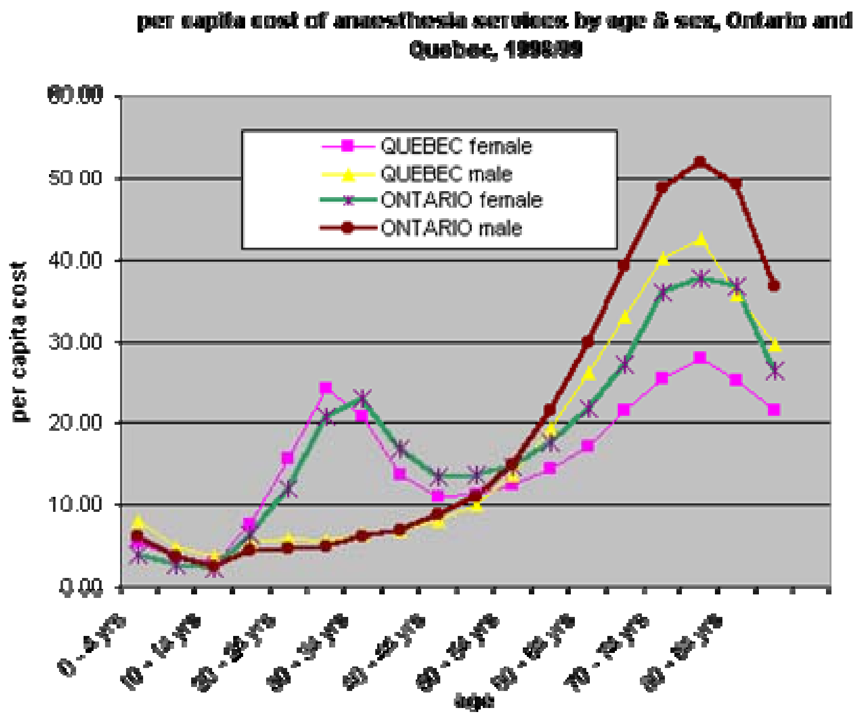
Each dollar spent on physician delivered clinical anesthesia services in 1998/99 in Quebec is considered as one unit of demand. The expression “unit of demand” will be used as a short cut for saying “unit of demand for clinical anesthesia services”. It is recognized that payments to physicians in Canada vary from province to province. What this means is that the actual dollar cost of one unit of demand will not be the same in provinces other than Quebec. The dollar value will vary by province within the same year and will alter with inflation in all provinces from year to year. This is totally irrelevant to the projections made in this report because it is only the relative values that are being projected. The projections of demand could be turned into cost projections if they are adjusted for changes in the rates at which anesthetists are paid in different provinces. However, that is not the purpose of this exercise.

Before making the projections we must answer some other questions related to doubts that might be raised by readers.

c) Can we generalize the utilization rates to the rest of Canada?

Table 1 and Graph 1 presented per capita utilization rates of anesthesia services for Quebec. In spite of the remarks in the previous paragraphs about units of demand and the actuarial basis of the relative rates of consumption of services by age and sex, some readers might still harbour doubts about the generalizability of the Quebec rates to other provinces. To answer this question in a convincing fashion data from Ontario are compared with the Quebec data. Together Quebec and Ontario accounted for 62% of Canada’s population in 1999, so if Ontario is comparable with Quebec, readers ought to be convinced.

The graph on the next page presents the per capita utilization of anesthesia services by age and sex for Ontario and Quebec plotted on the same graph with identical values for the vertical and horizontal axes. Thus, the comparisons are legitimate and any differences are immediately apparent.



For Ontario, the graph is based on the billings of anesthetists only. As family physicians provided 8.8% of the anesthesia services in Ontario in 1998, the per capita costs exclude 8.8% of billings. There is no reason to suppose that the demographics of the population served by family physicians are different from those of the population served by anesthetists so this is not a serious drawback. The per capita costs of anesthesia services for Ontario are 8.8% higher than those shown in the graph, ***but there is no reason to suppose that the shape of the graph would be different from what it is if family physician delivered anesthesia services were included in the distribution It is the shape of the graph that is relevant***. We know that physicians in Ontario are paid at a higher tariff than physicians in Quebec, so we expect the per capita costs to be higher in Ontario than Quebec. Higher per capita costs in Ontario are more a reflection of the higher tariff than of differential, higher consumption of anesthesia services. We can infer this from the similarity in the shapes of the curves on the graph for men as well as for women in Quebec and Ontario. Indeed, the graph for Ontario very closely resembles that for Quebec, demonstrating, once again, the underlying biological basis for demand and utilization of clinical anesthesia services. This graph provides the rationale for concluding that we can generalize the findings from Quebec to the rest of Canada.

d) Can we expect these rates of utilization to hold constant over the duration of the projection period?

Some readers will accept that at a single point in time we can use the differential rates of utilization of anesthesia services by age and sex as measured in one part of Canada as a guide to rates in other parts of Canada and yet wonder whether these rates will still apply at the target date of a planning cycle. In order to assess what degree of change there can be over time in utilization rates, an analysis was made of how rates of utilization of anesthesia services changed over a ten-year period in Quebec. Table 2 presents the results. (below)

If rates of utilization by age and by sex do not exhibit some underlying demographic regularity, they are useless for making projections. However, with the passage of time the rates can be expected to change for reasons that have little or nothing to do with demographic constancy. In the theoretical portion of this text, a number of such factors were listed. They included:

- Changing technology (example, less invasive technology eliminating need for anesthesia)
- Substitution of other types of health care workers for some services previously delivered by anesthetists
- Chemotherapy replacing surgery
- Introduction of new types of surgery
- Etc.

Over short periods of time such factors can be ignored, but not over the long haul. In Table 2 we get some idea of the magnitude of change over 10 years. Since the practice of medicine is very similar in all parts of Canada, we can assume that the changes that occurred in Quebec occurred elsewhere in Canada also.

The derivation of the numbers in Table 2 is a little complicated so an explanation of its contents follows.

In Table 2, the beneficiary population of Quebec is disaggregated by age and sex for the years 1988/89 & 1998/99. The beneficiary population figures come from the volume of "Annual Statistics" published yearly by RAMQ.

In the 2 columns following the columns containing population data, the amounts spent on physician-delivered anesthesia services in 1988/89 & 1998/99 are reported. The numbers in these 2 columns contain a slight adjustment to distribute across age groups the amount of billings that were not assigned by age and sex. The adjustment was made proportionately across all age groups and both sexes.

Table 2
Rates of Growth in Utilization of anesthesia by Age & Sex Between 1988/89 and 1998/99 in Quebec

Age	Beneficiary Population		$ Cost 1988/89	$ Cost 1998/99	$ PerCapita Cost 88/89	1988/89 $ Cost X1.28	Expected Cost 1998/99	Actual/ Expected 1998/99
	1988/89	1998/99						
Female Population								
0	40815	36672	264860	306772	6.49	8.31	304608	100.7
1-4	170601	173205	647863	837983	3.80	4.86	841923	99.5
5-9	232550	234843	706188	852582	3.04	3.89	912833	93.4
10-14	227670	216581	523278	628897	2.30	2.94	637173	98.7
15-19	226045	235679	1226958	1778713	5.43	6.95	1637441	108.6
20-24	280340	230281	2658774	3604985	9.48	12.14	2795532	129.0
25-29	331253	229219	4379694	5574104	13.22	16.92	3879221	143.7
30-34	324472	279233	3664003	5837736	11.29	14.45	4036038	144.6
35-39	288731	324355	2660752	4480300	9.22	11.80	3825971	117.1
40-44	255332	313351	2199471	3445404	8.61	11.03	3455047	99.7
45-49	201191	277701	1867388	3136134	9.28	11.88	3299236	95.1
50-54	169518	245444	1668282	3097099	9.84	12.60	3091833	100.2
55-59	171525	192206	1781932	2776973	10.39	13.30	2555881	108.7
60-64	160256	159355	2008560	2721480	12.53	16.04	2556502	106.5
65-69	137330	155738	2065560	3343565	15.04	19.25	2998313	111.5
70-74	107834	137784	1753635	3522269	16.26	20.82	2868086	122.8
75+	172271	239292	2783706	6098853	16.16	20.68	4949363	123.2
Total	3497734	3680939	32860905	52043849	9.39	12.03	44265087	117.6
Male Population								
0	43193	38133	458118	505666	10.61	13.58	517697	97.7
1-4	17931	179862	1106839	1301842	6.17	7.90	1421107	91.6
5-9	245213	244500	1017206	1225270	4.15	5.31	1298238	94.4
10-14	240004	227818	654587	811204	2.73	3.49	795330	102.0
15-19	238145	245941	1043888	1294940	4.38	5.61	1379919	93.8
20-24	290288	229120	1320816	1364518	4.55	5.82	1334401	102.3
25-29	338247	225958	1472176	1289886	4.35	5.57	1258819	102.5
30-34	330896	278387	1512588	1760383	4.57	5.85	1628876	108.1
35-39	291106	323100	1542494	2246430	5.30	6.78	2191388	102.5
40-44	258143	312095	1612713	2526025	6.25	8.00	2495706	101.2
45-49	203173	274363	1649808	2775204	8.12	10.39	2851694	97.3
50-54	166011	242120	1834870	3341228	11.05	14.15	3425382	97.5
55-59	162748	187490	2419390	3640407	14.87	19.03	3567618	102.0
60-64	142215	147602	2773530	3859542	19.50	24.96	3684594	104.7
65-69	110909	135477	2715133	4477606	24.48	31.34	4245217	105.5
70-74	78451	105560	2111637	4249706	26.92	34.45	3636890	116.9
75+	95454	128169	2394748	4911315	25.09	32.11	4115841	119.3
Total	3413507	3525695	27640542	41581172	8.10	10.36	36542686	113.8
TOTAL	**6911241**	**7206634**	**60501447**	**93625021**	**8.75**	**11.21**	**80751790**	**115.9**

For explanation, see text

Under the column entitled, “Per Capita Cost 88/89” is reported the average cost per person of anesthesia services in 1988/89.

Under the column “19988/89 $ Cost multiplied by 1.28”, is reported the average per capita costs in 1998/89 prices. This figure is obtained by multiplying 1988/89 average costs by 1.28. The Consumer Price Index in 1998 was 128, if the index was set at 100 in 1988.

The inflated prices make it possible to estimate what expenditures would have been, holding rates of consumption by age and sex constant. The calculations are reported in the column entitled, “Expected Cost 1998/99”.

The column entitled “Actual ÷ Expected” reports 1998/99 expenditures divided by the expected cost. When the number resulting from the division of actual by expected expenditures is multiplied by 100, the result is expressed as an index. In cases where actual expenditures = expected expenditures, the index = 100.

All numbers in the final column of Table 2 that are below 100, indicate a decrease in per capita utilization of anesthesia services. All numbers in the final column that are above 100 indicate an increase in per capita utilization.

To interpret these numbers, we should recall that the CPI is probably not a perfect deflator for these expenditure data. As has been mentioned, there were a number of years in Quebec during the decade of the ’90s in which physician earnings did not keep pace with the rate of inflation. Even so, the results reported in Table 2 are very instructive, as once again, it is the difference between the numbers for the different age groups that is telling. From these data we can be quite confident that some age groups experienced declines in per capita consumption and that some experienced increases when consumption rates in 19988/89 and 1998/99 are compared. (Even if the true deflator is closer, say, to 25% than 28%, because the deflator is a constant applicable to all measured rates, the relative difference between age groups would not change at all.)

Rates of utilization of anesthesia services by women increased by 17.6% on a per capita basis. The largest increases occurred for women aged 20-34, with a particularly large increase for women aged 25-34 years, prime reproductive ages (rates increased more than 40%). The other female age group that experienced heavy increased utilization was women aged 70+. The utilization of anesthesia by girls aged less than 15 dropped slightly between 1988/89 and 1998/99, as did the rate for women aged 45-49. It is easy to speculate that increased rates of utilization for women were associated with reproduction (reflecting the now routine use of epidurals in non-surgical obstetrics?) and the introduction of more cost-beneficial surgical interventions for older people. These are the kind of questions to which regular analysis of the content of anesthesia practice can provide answers. The only group of men whose rate of consumption of anesthesia services increased more than 5% was men aged 30-34 (8% increase), and men aged 65+. The rates for older men and women do demonstrate an increased willingness to provide surgical services to older segments of the population, a trend that is certain to continue into the future.

A more detailed analysis of changed utilization rates based on field of activity is given in Annex 2.

Table 3
Population Distribution of Quebec by Age and Sex in 1988 And in 1998 Compared with Consumption of Anesthesia Services by Age and Sex

AGE	1988/99		1998/99	
	Population Distribution %	Consumption Anesthesia Services %	Population Distribution %	Consumption Anesthesia Services%
Female				
< 1 yr	1.24	0.81	1.00	0.59
1 - 4 yrs	5.17	1.97	4.71	1.61
5 - 19 yrs	4.75	7.48	18.67	6.26
20 - 34 yrs	28.39	32.57	20.07	28.85
35 - 49 yrs	22.60	20.47	24.87	21.25
50 - 64 yrs	15.20	16.61	16.22	16.52
65 - 74 yrs	7.43	11.62	7.97	13.19
75+ yrs	5.22	8.47	6.50	11.72
total	100.00	100.00	100.00	100.00
Male				
< 1 yr	1.27	1.66	1.08	1.22
1 - 4 yrs	5.25	4.00	5.10	3.13
5 - 19 yrs	21.19	9.82	20.37	8.01
20 - 34 yrs	28.11	15.58	20.80	10.62
35 - 49 yrs	22.04	17.38	25.80	18.15
50 - 64 yrs	13.80	25.43	16.37	26.07
65 - 74 yrs	5.55	17.46	6.84	20.99
75+ yrs	2.80	8.66	3.64	11.81
total	100.00	100.00	100.00	100.00

For men as a whole, per capita utilization of anesthesia services increased 13.8% between 1988/89 and 1998/99, an overall rate lower than that of women.

It is time to answer the question posed at the beginning of this section. The data show that although demographic characteristics continue to be strongly associated (in a statistical sense) with utilization levels, the rates themselves do not remain static over long periods of time. The causes of change are to be found in changing norms of practice in the health care system. The data suggest that projections can be made using the measured rates of utilization, but that these rates need to be monitored and projections updated from time to time using new coefficients that reflect changing practice norms that develop with the passage of time. See Annex 2 for more on this topic.

Table 3, above, summarizes the changes in both population distribution and levels of consumption of anesthesia by age and sex that took place between 1988/89 and 1998/99. The principal message of Table 3 reinforces what we have learned already, that it is not only changes in the number of people to be served by the health care system that determines the resources, human and other, that are required, but also the demographic characteristics of the population to be served.

e) Applying the utilization rates to projected provincial populations in the year 2016

Because the actual computations involved in the projections are rather long and tedious, the detailed numbers for each province are grouped together in Annex 1. In this section, the results of the detailed projections are summarized.

In the annex that provides the projections for each province, a description is provided of how the projections were made. To understand the numbers in Table 4, it is recommended that the description in the annex be read prior to trying to follow the numbers in Table 4.

Table 4 (see next page) shows the projected number of units of demand for clinical anesthesia required by each province in the years 1999 and 2016. At first glance the numbers in the table may appear very difficult to interpret. It should help the reader to remember that 175000 units of demand equate to the full-time, full year workload of one anesthetist. This concept will be more readily understood if units of demand are thought of as a foreign currency and 175000 as the rate of exchange at which the services of one full-time anesthetist could be purchased.

The projections involve two sets of data. The first set of numbers involves population projections. The second is units of demand based on expected future population multiplied by per capita utilization. Table 5 shows rates of change in population and in units of demand required between 1999 and the year 2016. By comparing these two rates of change for both sets of numbers, we can study the extent to which future demand for clinical anesthesia services differs from rates of change in population. The figures in Table 5 are calculated from the numbers given in the annex for each province. The numbers are expressed as an index, with the values for 1999 set at 100.

The numbers in Table 5 are striking. In order to appreciate the significance of this table, all that is required is to recall the passages of the theoretical part of this report that discuss population /physician ratios (PPRs). A plea was made for rejecting PPRs as tools in workforce planning unless they are adjusted to reflect demographic composition. This statistical table shows why. ***Projected demand for clinical anesthesia services considerably exceeds projected growth in population even though age/sex rates of per capita utilization are held constant over the projection period***. Here are some of the conclusions we can reach based on Tables 5 and 6.

The projected demographic future of the provinces diverges dramatically. For example, all population projections (low, medium or high levels of projected growth) for Newfoundland in the year 2016 show an expected population decline. At the other extreme, British Columbia may experience population growth as high as 37% in the next 17 years. Other provinces expected to have high population growth are Ontario, Alberta and the Territories, (Yukon, N.W.T. and Nunavat). Quebec's population is expected to grow at a modest rate to the year 2016 under all scenarios. The entire Atlantic area, Newfoundland and the three Maritime provinces, as well as

Table 4
SUMMARY OF DEMAND PROJECTIONS BY PROVINCE

Province	Sex	Projected Units of Demand				
		1999	2016			
			Low	Medium	High 1	High 2
Newfoundland	male	3128578	3431354	3646887	3885317	3564420
	female	3806822	3564974	3826009	4127981	3666343
	total	**6935400**	**6996328**	**7472896**	**8013298**	**7230763**
P.E.I.	male	800938	937240	977781	1021208	978321
	female	978017	1024661	1079597	1138094	1056038
	total	**1778955**	**1961901**	**2057378**	**2159302**	**2034359**
Nova Scotia	male	5508518	6624187	6840418	7082529	6953969
	female	6825433	7039280	7308753	7605132	7303836
	total	**12333951**	**13663467**	**14149171**	**14687661**	**14257805**
New Brunswick	male	4440073	5249402	5355004	5474778	5443347
	female	5425240	5498760	5633371	5773322	5638883
	total	**9865313**	**10748162**	**10988375**	**11248100**	**11082230**
Quebec	male	42758139	53360484	53828627	54608945	56117825
	female	52781945	58340479	58658540	59205603	60935748
	total	**95540084**	**111700963**	**112487167**	**113814548**	**117053573**
Ontario	male	66553141	88162892	91071777	94312120	95148977
	female	82510203	100726615	103356597	106107841	108502015
	total	**149063344**	**188889507**	**194428374**	**200419961**	**203650992**
Manitoba	male	6692559	7953462	7948688	7954333	8356429
	female	8089434	8714581	8650724	8574788	9097420
	total	**14781993**	**16668043**	**16599412**	**16529121**	**17453849**
Saskatchewan	male	6143944	7049962	6874017	6721213	7354410
	female	7195360	7765489	7455981	7173348	8025703
	total	**13339304**	**14815451**	**14329998**	**13894561**	**15380113**
Alberta	male	16173634	21620517	22963113	24420830	22839231
	female	20012695	23574194	25267772	27088715	24808086
	total	**36186329**	**45194711**	**48230885**	**51509545**	**47647317**
British Columbia	male	23940524	32992681	34878990	36901882	35606173
	female	28741953	35995352	38505574	41171215	38935022
	total	**52682477**	**68988033**	**73384564**	**78073097**	**74541195**
Territories	male	580133	825954	838960	866808	885692
	female	466960	678401	676366	693751	691865

	total	**1047093**	**1504355**	**1515326**	**1560559**	**1577557**
CANADA	male	176607008	228060582	235061668	243076906	243248794
	female	216947235	253070339	260581878	268832847	268660959
	total	**393554243**	**481130921**	**495643546**	**511909753**	511909753

For explanation, see text

Table 5
Comparison of Rates of Population Change for Each Province by the year 2016 & Rates of Change in Projected Demand for Clinical anesthesia Services by Province in 2016

Province	**Population in 2016, If 1999=100**				
	1999	LOW	MEDIUM	HIGH 1	HIGH 2
Newfoundland	100.0	83.9	91.0	99.4	87.4
P.E.I.	100.0	96.2	102.2	109.0	101.2
Nova Scotia	100.0	95.6	100.0	105.3	101.3
New Bruns.	100.0	93.4	96.0	99.1	97.4
Quebec	100.0	102.1	103.0	105.3	108.9
Ontario	100.0	114.6	119.0	124.1	126.4
Manitoba	100.0	101.6	101.4	101.5	108.3
Saskatchewan	100.0	100.2	96.5	93.4	105.7
Alberta	100.0	107.8	113.6	126.8	115.8
Br. Columbia	100.0	117.2	126.5	136.9	129.6
Territories	100.0	122.5	123.7	128.0	130.8
CANADA	100.0	108.6	112.8	117.9	117.9
	Projected demand for clinical services by 2016, If 1999=100				
	1999	LOW	MEDIUM	HIGH 1	HIGH 2
Newfoundland	100.0	100.9	107.8	115.5	104.3
P.E.I.	100.0	110.3	115.7	121.4	114.4
Nova Scotia	100.0	110.8	114.7	119.1	115.6
New Bruns.	100.0	108.9	111.4	114.0	112.3
Quebec	100.0	116.9	117.7	119.1	122.5
Ontario	100.0	126.7	130.4	134.5	136.6
Manitoba	100.0	112.8	112.3	111.8	118.1
Saskatchewan	100.0	111.1	107.4	104.2	115.3
Alberta	100.0	124.9	133.3	142.3	131.7
Br. Columbia	100.0	131.0	139.3	148.2	141.5
Territories	100.0	143.7	144.7	149.0	150.7
CANADA	100.0	122.3	125.9	129.1	129.1

Derived from provincial projections. See annex

Manitoba and Saskatchewan are all expected to face population decline under at least one of the four population scenarios for 2016. In these 6 provinces any population growth at all between now and 2016 will be, at best, modest.

For Canada as a whole population growth is expected to range between an increase of approximately ½ % to 1% per annum, ½% under the low growth scenario, 1% under the high growth scenario. The medium level scenario predicts population growth of roughly $^{2}/3$%.

It will be quickly appreciated, looking at the figures for individual provinces and comparing them with the Canada totals, that the figures for Canada alone would not be much of a guide to any particular province in understanding its own future health care requirements. This underlines how important it is to study the data for each province separately.

Turning to rates at which we can expect demand for clinical anesthesia services to grow or decline, the findings are these:

The projected future demand for clinical anesthesia services is considerably higher than the rate of growth of population numbers. Because of the ageing of the population, this in itself will not come as a surprise. What is new and interesting about these numbers is that they provide estimates of the order of magnitude of increases in requirements that are brought about entirely by changes in demographic composition (distribution by age and sex of the population), as opposed to changes in absolute numbers alone.

For each province, it will be instructive to know what proportion of future health care requirements will arise out of demographic composition changes, particularly because traditionally, this factor is ignored in calculations of requirements.

The arithmetic is easy and works out as shown in Table 6. Table 6 splits expected change in demand for clinical anesthesia services into two components. The first is the % change expected based on overall population change. This is the amount that traditional methods of projecting future demand would arrive at. The second component is the amount of future demand generated by the changing age/sex composition of the population. ***This second component is the amount of future demand that is missed by using non-standardized PPRs.***

The calculations in Table 6 apply only to the specialty of anesthesia and should not be thought of as indications of future demand for other types of physicians. However, because so much of anesthetists' work is in connection with surgery, these projections must have some bearing upon future requirements for surgery also.

The rates apply to changes in demand for anesthesia services between the years 1999 and 2016 only. Any one using these methods for making projections must make their own calculations based on the time periods and specialty they are dealing with.

Table 6 presents calculations for each of the provinces and the Territories. The source of the numbers is the calculations shown in Table 5.

Table 6
Impact on Demand for Clinical anesthesia Services of Change In Demographic Composition Between 1999 & 2016, Canada and Provinces

Province	Reason For Change	% Increase Between 1999 and the Year 2016			
		Low	Medium	High 1	High 2
Newfoundland	Population	- 16.1 %	-9.0 %	- 0.6 %	-12.6 %
	Demand	+ 0.9 %	+ 7.8 %	+15.5 %	+ 4.3 %
	Dem. Comp.	+ 17.0 %	+16.8 %	+16.1 %	+16.9 %
Prince Edward Island	Population	- 3.8 %	+ 2.2 %	+ 9.0 %	+ 1.2 %
	Demand	+10.3 %	+15.7 %	+21.4 %	+14.4 %
	Dem. Comp.	+14.1 %	+13.5 %	+12.4 %	+13.2 %
Nova Scotia	Population	- 4.2 %	0.0 %	+ 5.3 %	+ 1.3 %
	Demand	+10.8 %	+14.7 %	+19.1 %	+15.6 %
	Dem. Comp.	+15.0 %	+14.7 %	+13.8 %	+14.3 %
New Brunswick	Population	- 6.6 %	+ 4.0 %	- 0.9 %	- 2.6 %
	Demand	+ 8.9 %	+11.4 %	+14.0 %	+12.3 %
	Dem. Comp.	+15.5 %	+15.4 %	+14.9 %	+14.9 %
Québec	Population	+ 2.1 %	+ 3.0 %	+ 5.3 %	+ 8.9 %
	Demand	+16.9 %	+17.7 %	+19.1 %	+22.5 %
	Dem. Comp.	+14.8 %	+14.7 %	+13.8 %	+13.6 %
Ontario	Population	+14.6 %	+19.0 %	+24.1 %	+26.4 %
	Demand	+26.7 %	+30.4 %	+34.1 %	+36.6 %
	Dem. Comp.	+12.1 %	+10.6 %	+10.4 %	+10.2 %
Manitoba	Population	+ 1.6 %	+ 1.4 %	+ 1.5 %	+ 8.3 %
	Demand	+12.8 %	+12.3 %	+11.8 %	+18.1 %
	Dem. Comp.	+11.2 %	+10.9 %	+10.3 %	+ 9.8 %
Saskatchewan	Population	+ 0.2 %	- 3.5 %	- 6.4 %	+ 5.7 %
	Demand	+11.1 %	+ 7.4 %	+ 4.2 %	+15.3 %
	Dem. Comp.	+10.9 %	+10.9 %	+10.6 %	+ 9.6 %
Alberta	Population	+ 7.8 %	+13.6 %	+26.8 %	+15.8 %
	Demand	+24.9 %	+33.3 %	+42.3 %	+31.7 %
	Dem. Comp.	+17.1 %	+19.7 %	+15.5 %	+15.9 %
British Columbia	Population	+17.2 %	+26.5 %	+36.9 %	+26.6 %
	Demand	+31.0 %	+39.3 %	+48.2 %	+41.5 %
	Dem. Comp.	+13.8 %	+19.7 %	+11.3 %	+11.9 %
Territories	Population	+22.5 %	+23.7 %	+28.0 %	+30.8 %
	Demand	+43.7 %	+44.7 %	+49.0 %	+50.7 %
	Dem. Comp.	+21.2 %	+21.0 %	+21.0 %	+19.9 %
CANADA	Population	+ 8.6 %	+12.8 %	+17.9 %	+17.9 %
	Demand	+22.3 %	+25.9 %	+29.1 %	+29.1 %
	Dem. Comp.	+13.7 %	+13.1 %	+11.2 %	+11.2 %

Dem. Comp. = demographic composition
For explanation, see text

Table 6 reports 3 numbers for each province. The first item labeled “Population” reports the % change in expected population between 1999 and the year 2016. The second is the calculated change in projected future demand for anesthesia services.
By subtracting from the projected future demand the amount that is due to population change, we calculate the amount due to demographic change. For example, the figure for Newfoundland for the “low” population projection for the year 2016 shows minus 16.1% population growth expected between 1999 and 2016. If demand for health care services exactly mirrored population changes, Newfoundland could look forward to a 16.1% reduction in future anesthesia requirements, if the low population projection materialised in 2016. Instead the demand calculations, reported under the label “demand” give a figure of +0.9% increase in estimated future requirements. By inference, the difference between the two numbers must be due to changed demographic composition. In short, the segments of the population that are higher than average consumers of anesthesia services are growing faster than the segments of the population that are lower than average users. This is so because age/sex utilization rates have been held constant over the entire projection cycle.

Readers will note that the demographic change component will be a greater factor in bringing about increases in demand for anesthesia services than changes in overall population. Although some provinces will experience heavy population growth and some very little, ***all provinces will be faced with providing substantial increases due to demographic change, largely ageing of the population***.

The population projections provided by Statistics Canada appear on the low side compared with rates of population growth in Canada in the recent past. For this reason, users of these numbers should be looking at the high projections as being perhaps, more realistic. If this is the case, Canada as a whole can expect an increase in the demand for clinical anesthesia services of the order of 30% over a 17-year period.

It is time to assess what this increased demand for services means in terms of the number of anesthetists required in the future.

f) Translating demand for anesthesia services into number of anesthetists required

- Anesthetists required for clinical service

In this section the demand figures for each of the provinces will be converted to full-time requirements. This will be done using the rate of conversion, 1 full-time, full-year anesthetist = 175000 units of demand. This will provide the number of FTE anesthetists required to provide clinical service.

The first point to note is that the total number of anesthetists required must include people to perform tasks other than the provision of clinical services. An attempt will be made to quantify requirements arising out of non-clinical activities also.

Table 7
Estimated demand* for full workload anesthetists for the provision of clinical service in 1999 and in 2016

PROVINCE	1999	2016			
		LOW	MEDIUM	HIGH 1	HIGH 2
Newfoundland	40	40	43	48	41
P.E.I.	10	11	12	12	12
Nova Scotia	70	78	81	84	81
New Brunswick	56	61	63	64	63
Quebec	546	638	643	650	669
Ontario	852	1080	1110	1145	1164
Manitoba	85	95	95	94	100
Saskatchewan	76	85	82	79	88
Alberta	207	258	275	294	272
British Columbia	301	394	419	446	426
Territories	6	9	9	9	9
Canada	2249	2749	2832	2925	2925

*Demand for anesthetists for clinical service only

Table 7 expresses units of demand for clinical anesthesia services in each province in terms of FTE requirements.

For many readers, the numbers in Table 7 will be far easier to come to grips with than those counting units of demand. Particularly, the numbers for 1999 will resonate, because we have real data for 1999, with which we can compare the projected numbers. Earlier, it was mentioned that the year 1999 was included in the projections for 2 reasons. The first was to have a benchmark against which rates of growth or decline in future projected demand could be measured. The second reason was for interested parties to judge for themselves whether the model churns out credible projections. Before making the comparison between the demand estimates delivered by the model and the actual supply situation in 1999, the requirements for anesthetists in 1999 must be increased to reflect the need for non-clinical work to be performed.

- **Anesthetists required for non-clinical service**

The principal components of professional, non-clinical activities for anesthetists are academic and administrative.

No comprehensive, regularly conducted surveys exist to provide the data that would enable ongoing measurements of requirements for anesthetists arising out of essential, non-clinical activities. The numbers presented below take a stab at assessing this important variable for physician workforce planning. A working model would require regular statistical surveys to collect the data in a systematic way.

In this section, we will deal separately with academic requirements and with administrative requirements that occur outside the academic environment.

Academic activities include teaching, research and the administration of academic programmes. Most teaching takes place in the context of service delivery and the estimates of future requirements for the provision of clinical services include the time spent in on-the-job clinical instruction and supervision. In order to avoid double counting, we are only concerned with add-on teaching related activities, such as class-room teaching, preparation and conduct of examinations, curriculum review and design, provision of continuing education courses, etc.

How involved are anesthetists in the 16 departments of anesthesiology of Canada's 16 medical schools? Every year, the Association of Canadian Medical Colleges publishes statistics related to number and rank of faculty members appointed to medical schools. The numbers given here come from the forthcoming issue of "Canadian Medical Education Statistics, 2000".
The 16 academic departments of anesthesia had 1347 appointees in 1998/99
The breakdown was as follows:

Full-time: 365	total
98	associate professors
175	assistant professors
Part-time: 982	total
182	part-time paid
800	volunteer

CMA data show that on Jan.1, 1999 (the date closest to the collection date of the faculty data), there were 2266 professionally active anesthetists in Canada. If 1347 of them had full or part-time appointments in Canadian medical schools, then nearly 60% (59.4%) of all anesthetists in Canada have some connection with academic medicine, meaning that nearly 60% do some teaching or research or administration in connection with academic programmes. For many this academic activity is supervising trainees during the course of service delivery.

For others, it is some combination of the activities described in earlier paragraphs.

To try to express the amount of academic, non-clinical work in terms of FTE anesthetists, two data sources were used. By comparing the results from the two very different sources, we can assess whether they produce approximately similar results. If so, we can presume to have established a reasonable starting point for measuring non-clinical manpower requirements, given the absence of dedicated surveys. If the two sources produce irreconcilable differences in the estimates, it would be advisable to wait for a proper survey to be conducted. ***What is not acceptable, is to ignore in planning, the non-clinical component of anesthetist professional activities.***

The first source of data used in the estimate is a time study performed by the Department of Anesthesia of the University of Toronto in conjunction with the administration of the departmental practice plan. The numbers come from the 1997/98 academic year. Similar data for the 1996/97 academic year produced almost identical results.

In 1997/98, the U. of Toronto Department of Anesthesia employed 145 faculty members in its various affiliated hospitals. During the course of the year, these 145 faculty members spent 33586 staff hours on the following academic activities:

Administration	5019 hours
Teaching	7153 hours
Research	21414 hours
TOTAL	**33586 hours**

If we assume that a full-time, full-year anesthetist works 48 weeks per year and 48 hours per week, the hours worked per year of a full-time, full-year anesthetist is 48 x 48 = 2304 hours per year. If the norm for hours worked per week is set at 50 hours (remember, in the world outside clinical medicine, the usual, full-time work week is set at 37.5 hours), the number of hours worked per year would be 48 x 50 =2400 hours per year.

By dividing the number of academic, non-clinical hours by 2304 or by 2400, we get the non-clinical FTE figure of 14 or 15 FTEs, depending on the assumption regarding the norm for hours worked per week. (33586÷2304 = 15; 33586÷2400 = 14)

If each of the 145 faculty members at the U. of Toronto worked on average 48 or 50 hours per week, we can calculate that non-clinical academic work absorbed 10% of their time over the year. (Total hours worked, including clinical, = 145 x 48 x 48 = 334080 hours, or 145 x 48 x 50 = 348000 hours. 33586 is 10% of 334080 or 9.65% of 348000)

If 10% of the time of all faculty appointed to university departments of anesthesia is devoted to non-clinical pursuits, then the FTE equivalent for all faculties of medicine would be 135 (1347 x 10%). Because the U. of Toronto's Department of Anesthesia is more heavily active than most other faculties of medicine in research, generalizing its level of academic activity to all faculties of medicine probably overstates the case. We should think of the number 135 FTEs as a generous estimate of non-clinical academic activity in anesthesiology in Canada in 1997/98.

The second source of data covers all anesthetists whether appointed to faculties of medicine or not. The source is the "1995 RCPSC Specialty Physician Workforce Study"

In 1995, the RCPSC sent a questionnaire to all certificants believed to be in Canada at the time of the survey. The survey covered the practices and work patterns of specialists and included questions on time spent in different types of activities. Some results from that survey are used here to estimate FTE equivalent time spent in non-clinical activities.

In 1995, the RCPSC numbered 2119 certificants in anesthesia among its members. Of these 2119 who received a questionnaire, 1558 or 73.5 % provided analysable responses. There were 562 anesthetist non-respondents. Information about follow-up of non-respondents was not provided by specialty, but in aggregate only. The aggregated data showed that 84.8% of non-respondents were believed to be professionally active in Canada, whereas 15.2% were not. Some had retired, some had died, and some were outside Canada. Applying the figure 84.8% active to the 561 anesthetist non-respondents, suggests that, the true number of non-respondents was closer to 476 than to 561. In making the estimates of non-clinical activity, the estimates will be based on 1558 + 476 =2034 professionally active certificants in anesthesiology in Canada in 1995. The corrected response rate to the survey is estimated as 76.6%, which is an exceptionally high response rate to a survey of this kind. Of the 1558 respondents to the RCPSC survey, 1395 answered the questions related to hours per week worked and the work activities engaged in. Thus, for the questions of interest to us, 1395 (or 68.6%) of the 2034 professionally active anesthetists provided replies.

Table 8 provides the data derived from the 1995 Royal College survey related to the work patterns of anesthetists. (See below)

From this table, we can also make some inferences as to the amount of time spent by anesthetists in non-clinical academic activities and in administrative tasks not concerned with academic programs. Because the management of academic programmes, both teaching & research, is included with the teaching and research data, the figures described under the label, "administration" in Table 8, refer only to non-academic administration.

Let us start with the academic component. Interested readers can compile the figures separately for teaching and research, here the calculations are based on the combined numbers for teaching and research. These data are reported under "Academic Activities,sub-total".

Table 8
Range of Hours Worked by anesthetists Per Week by Activity in 1995

Hours Worked Per Week	Practice Activities	Administration	Academic Activities			Total
			Research	Teaching	Sub-total	
0 hours per week	12	588	1091	864	802	0
1-4 hours per week	3	632	161	365	312	2
5-19 hours per week	36	161	116	155	232	21
20-39 hrs. per week	373	8	26	8	48	167
40+ hours per week	971	6	1	2	4	1205
Total	1395	1395	1395	1395	1395	1395

Source: *Table D2 of 1995 RCPSC Specialty Physician Workforce Study*

Notes: "Research" includes managing research programmes and publications. "Teaching" includes managing university educational programmes.

The sum of teaching and research differs from the sub-total because some anesthetists do both.

The calculations of number of FTEs used for non-clinical academic activities of the 1395 anesthetists who reported their work hours are shown here:

802	Spent 0 hours	0 av. hours	0 total hours
312	Spent 1-4 hours	2 av. hours	624 total hours
232	Spent 5-19 hours	12 av. hours	2784 total hours
48	Spent 20-39 hours	30 av. hours	1440 total hours
4	Spent 40+ hours	48 av. hours	192 total hours

TOTAL	**5040 hours weekly**
If average workweek = 48 hours	105 FTEs
If average workweek = 50 hours	101 FTEs

Now, 1395 respondents represented just under 70 % of anesthetists in 1995. We need to gross up the calculations to account for the non-respondents. If we increase the amounts by 30% to allow for non-response, the academic, non-clinical FTEs in 1995 amounted to approximately the workload of 131 to 136 full-time anesthetists.

How does this set of estimates compare with the ones based on the U. of Toronto data? Although the estimates are derived from totally different sources, surveys and methodology and are for two different years, the results are remarkably concordant. The degree of concordance is such that they can be used in conjunction with the demand estimates for clinical anesthesia services.

An estimate of the FTE equivalents used for administration in a non-academic context was made using the same method as for the academic component.

588	Spent 0 hours	0 av. hours	0 total hours
632	Spent 1-4 hours	2 av. hours	1264 total hours
161	Spent 5-19 hours	12 av. hours	1932 total hours
8	Spent 20-39 hours	30 av. hours	240 total hours
6	Spent 40+ hours	48 av.hours	288 total hours
		TOTAL	**3724 hours weekly**
		If average workweek = 48 hours	78 FTEs
		If average workweek = 50 hours	74 FTEs

Once again, if we gross up the FTEs calculated for the 1395 respondents by 30% to allow for the activities of non-respondents, we arrive at a calculation of approximately 96-101 FTE anesthetists' time used in non-academic administration in 1995.

The total non-clinical workload of anesthetists is estimated to have been the equivalent of the full-time work of between 227 and 237 anesthetists. This is the sum of academic, non-clinical of approximately 131-136 FTEs and administration that is not connected with academic medicine of 96-101 FTEs.

If we examine these numbers carefully, they do not look unreasonable. What would, indeed, be unreasonable would be to omit from estimates of future requirements the workload that is not clinical in nature.

To make use of these estimates alongside the estimates of requirements for clinical service, we need to update them to 1999 and the year 2016.

For the year 1999, a simple calculation will be made that numbers should increase at the same rate as the numbers for clinical service, i.e. at 1 ½ to 2% per annum. For 1999, at an annual rate of increase of 1 ½% per annum, this would bring the numbers to 241-252 FTE anesthetists required for professional, non-clinical work.

When it comes to making estimates for the year 2016, there are many imponderables. We are probably just on the threshold of a major expansion in the capacity of Canada's faculties of medicine, which will bring in its wake growth in all academic functions. The rate of growth in demand for anesthetists to participate in teaching and research will expand concomitantly. If the non-clinical workload increases by 30-50% by the year 2016, the FTE equivalent number of anesthetists required in 2016 will be approximately 315-375.

In order to be able to combine the estimates of FTE requirements for clinical and non-clinical services, it is necessary to allocate the non-clinical requirements by province.

The figures were allocated in the following way:

Allocation was made separately for teaching, for research and for administration. The numbers for teaching and research include the administration of teaching and research programmes. The numbers for administration are for administration in the context of the delivery of clinical care and all other non-academic activities. The teaching component was allocated by province on the basis of the number of Post-M.D. trainees in anesthesiology; the research component was allocated by province on the basis of 1998/99 health research expenditures in anesthesiology reported to ACMC in the annual research expenditures survey; the non-academic administration component was allocated by province in proportion to estimated demand for clinical services in 1999.

The results are summarised here:

Table 9
Allocation of Non-clinical FTE Requirements by Province, 1999

Province	Teaching	Research	Admin.	Total
NF	2	0	2	4
PEI	0	0	0	0
NS	3	4	3	10
NB	0	0	3	3
QC	22	13	25	60

ON	34	35	39	108
MB	4	3	4	11
SK	2	1	4	7
AB	7	5	10	22
BC	5	2	14	21
TR	0	0	0	0
CANADA	**79**	**63**	**104**	**246**

Less than 1 is shown as 0
All data are estimates by author, derived as described in text

Table 10 summarises, in FTEs, the requirements for physicians to deliver anesthesia services in 1999 that the proposed model generates. The demand for clinical and non-clinical services is shown for each province. The purpose of this exercise is to test the model. People familiar with the practice of anesthesia can judge for themselves whether the numbers generated reflect the situation as they know it to have been last year. In addition to showing the projected demand for anesthesia services expressed in FTEs, the projections will be compared province by province, with the number of available anesthetists. We will then carry out some of the other steps suggested in the theoretical section, such as translating FTEs into head counts of physicians required. This will provide a province-by-province estimate of the extent of deficits or surpluses of anesthetists.

Table 10 provides approximate (unadjusted) estimates of the supply situation in anesthesia by province in 1999. The numbers compare requirements, as calculated by the model, with supply. Anyone who is familiar with physician workforce studies will realise that one of the most problematic areas is trying to assess, at the outset of a planning cycle, whether there is a balance, surplus or deficit, and its extent.

However, to make use of these data, we need to deal with two issues. We must factor in the amount of work done by non-anesthetists and we must convert requirements expressed in FTEs into a head count of anesthetists required.

Table 10
Comparison of Requirements for anesthetists in 1999 with the Number of anesthetists Available in 1999. CANADA and PROVINCES

PROVINCE	**FTEs REQUIRED IN 1999**			**1/1/2000 Head Count Anæsthetists**	**Balance: Deficit or Surplus**
	Clinical Service	**Non-Clinical**	**Total**		

Nfld.	40	4	44	34	-22.8%
P.E.I.	10	0	0	6	
N.S.	70	10	80	92	-4.7%
N.B.	56	3	59	44	
(s.t. Mar.)	(136)	(13)	(149)	(142)	
QC.	546	60	606	549	-9.4%
ON.	852	108	960	846	-11.9%
MN.	85	11	96	95	-1.0%
SK.	76	7	83	61	-26.5%
AB.	207	22	229	209	-8.7%
B.C.	301	21	322	350	+8.7%
TERR.	6	0	6	1	..
CANADA	**2249**	**246**	**2495**	**2287**	**-8.3%**

.. Many services delivered in other province

Notes:

1. The surplus/deficit calculations are made comparing head counts with FTEs. To the extent that on average, head counts deliver fewer than 1 FTE of work each, the deficit/surplus situation has to be corrected to reflect the actual amount of work delivered. See text for elaboration of this.
2. The deficits are calculated ignoring the contribution of GP anesthetists and of other physicians. See text for further discussion of this item.

- **Adjusting for amount of work performed by non-anesthetists and the real workloads of physicians**

Unfortunately, the author has not located data that measure the contribution of non-anesthetists to the delivery of anesthesia services for all provinces. This section can include data only for Quebec, Ontario and Alberta at this time. It would be useful for other provinces to provide similar data and complete the analysis pertaining to anesthesia supply in their own jurisdiction.

Table 11
Relationship Between anesthesia Physician Requirements in 1999 and Head Counts and FTE Counts of Physicians Delivering anesthesia Services

	QUEBEC	**ONTARIO**	**ALBERTA**
1) FTE Requirements (from model)	606	960	229
2) Billings Data			

Anesthetist: Head Count	529	805	215
Family Phys: Head Count	189	468	103
3) Billings Data			
Anæsthetists: FTE Count	555	822	181 (211)
Family Phys: FTE Count	23 (578)	80 (902)	32 (15) (223) (226)
4) CMA Database			
Anæsthetists: Head Count 1/1/2000	549	847	209

Notes:
The data for Alberta were based on self-reported hours of work. They are not strictly comparable with data derived from actual billings for services delivered. The first set of figures for Alberta under section 3 above come from the Alberta Physician Resource Data Base in a report entitled "College of Physicians and Surgeons, Specialist Counts & Full-time Functional Equivalents", March 1999. The second set of numbers was derived 1) FTE count of anesthetists, from a statistical distribution of hours worked by age as reported to the CPSA. 2)The FTE count for family physicians in Alberta was estimated by the author based on the number of family physicians in Alberta who reported that they delivered some anesthesia services.

Sources:
Quebec - RAMQ data 1998/99
Ontario - OMA OHIP billings data, 1998/99
Alberta - See notes above

Table 11 illustrates just how difficult it is to assess the state of physician supply from 1 or 2 seemingly simple statistical measurements. Let us examine what it is that these numbers do tell us.

The model suggests that, in 1999, Quebec needed anesthesia services that would occupy the working time of 606 physicians working full-time. The billings data tell us (and these numbers are 100% comprehensive and reliable) that anesthesia services were delivered in 1998/99 by 529 anesthetists and by 189 family physicians/G.P.s. By computing the total value of the services delivered, we learn that anesthetists delivered the work equivalent of 555 full-time anesthetists. Family physicians delivered the equivalent of the work of 23 full-time anesthetists. Thus together, they delivered the work of 578 full-time anesthetists. The CMA database counted 549 anesthetists as of 1/1/2000. For Quebec, the very heavy average workload of anesthetists somewhat compensated for the shortage of physicians, so that the shortage based on measuring actual amount of work done reduces the calculated shortage from –9.4% (see Table 10) to -4.6% (100 –578/606). The implication of this is that many anesthetists in Quebec are working very long hours indeed. The high average working time per year was achieved in spite of considerable differentials in working time by age and by sex. (See data below). As to the comparison of the physician counts derived from actual work performed and the counts from the principal national databases, they will be discussed under the section related to physician stocks.

For Ontario, we can conduct the same type of analysis as for Quebec. Based on billings, 805 anesthetists and 468 G.P.s delivered anesthesia services. The FTE workload was 822 for anesthetists and 80 for G.P.s. Together, they delivered the workload of 902 full-time anesthetists. In the case of Ontario also, the average workload of anesthetists over all ages and both sexes was higher than 1. The calculated shortage of anesthetists is reduced from –11.9% (as measured in Table 10) to –6.0%, once the contribution of G.P.s and the heavy workloads of anesthetists are factored in. As with Quebec, the head counts of anesthetists recorded in the CMA database are higher than the numbers who actually delivered services.

Understanding the data from Alberta is a little more problematic, because self-reported hours of work are a less reliable statistical measurement of work performed than is billings. Nevertheless, a few words will be said about the numbers from Alberta. In particular, the FTE equivalent for anesthetists seems to have been underestimated. Based on the data from Alberta, which report hours worked by age, the author re-calculated the FTE equivalents for anesthetists and arrived at the figure of 211 instead of 181, a very substantial difference of 30 FTEs. On the other hand, the FTE equivalent for non-anesthetists seemed very high when compared with Ontario and Quebec. What seemed very high was the ratio of G.P.s delivering anesthesia services compared with the FTE equivalent workload delivered. Since the Ontario and Quebec numbers were based on billed services, an alternative FTE estimate of 15 is shown. This was done to point out the uncertainties pertaining to many important variables and the need to measure them accurately.

The inclusion of G.P. delivered services and an average workload of almost exactly 1 for Alberta, reduces the calculated shortage reported in Table 10 to 1.3% using the second set of figures for Alberta and to 7% using the first set of figures. If the second set of figures is closer to reality, then the shortage for Alberta in 1999 was minimal.

In the absence of data for the other provinces, it is important that the shortage or surplus figures given in Table 10 not be quoted without some adjustment to include measurements of the contribution of G.P.s to the delivery of anesthesia services and a measurement of the real workload of physicians, which we have seen can be greater than 1 FTE.

Before closing this section, two more topics must be dealt with as they illustrate some problems that arise with operating physician workforce planning models.

Age/Sex Differences in Workloads.

In the statistics reported in Table 11, we find that in both of the provinces for which objective data were available, the average workload of anesthetists in 1998/99 was above unity (i.e., on average, anesthetists were working more than the equivalent of 1 full-time unit). Given the age spread of anesthetists, this is an unexpected finding and in itself a very clear indication of shortage. The data for Ontario and Quebec, based on average billings alone suggest shortages and a situation in which working long hours is a response to need. Because this is the case, it is necessary to study the demographics of physician workloads. Once again, it is not possible to include data for all provinces here. Data will be provided for Quebec and Alberta because recent data for these 2 provinces are readily available.

In interpreting the data, readers should keep in mind that there was probably a shortage of anesthetists of approximately 4 to 5% in Quebec and of 1% in Alberta at the time these data were collected.

Table 12
Average Hours Worked Per Year by anesthetists in Alberta, 1999

AGE	Hours Worked	Total Hours	FTEs	Head Count	Index
30-34	2833	59493	24.8	21	118
35-39	2683	69758	29.1	26	112
40-44	2478	136290	56.8	55	103
45-49	2427	116496	48.5	48	101
50-54	2541	63525	26.5	25	106
55-59	2281	20529	8.6	9	95
60-64	1916	26824	11.2	14	80
65-69	2275	11375	4.7	5	95
70+	259	2072	0.9	8	11
TOTAL	**2400**	**506362**	**211**	**211**	**100**

Full Workload = 2400 hours per year

The data reported for Alberta in Table 12 did not provide a disaggregation by sex. The data demonstrate decisively the fact that the age composition of the physician workforce makes a large difference to the amount of work that is forthcoming from a given number of anesthetists. Younger physicians work considerably longer hours than older ones. The very oldest work hardly at all and their inclusion in the head counts is misleading. The 8 anesthetists aged 70 or older produced the workload of 1 full-time physician only.

The principal significance of these data is the need to include the age composition of the expected workforce in planning the number of anesthetists required in the future. The second consideration is, that at times of shortage, it may be possible to elicit increased workloads from physicians. Alberta still has some way to go in this respect. The fact that the FTE equivalent works out at exactly 1 compared with the head count, suggests that the supply situation with respect to anesthetists in Alberta is not nearly as grave as it is in Quebec or Ontario.

We will now turn to the more complete data from Quebec. These numbers come from the same data set as all the other statistics for Quebec used in this report. Table 13 compares the earnings of male and female anesthetists in Quebec in 1998/99 by age. This permits a concurrent examination of the impact of both age and of sex on workforce behaviour.

Table 13
Average Earnings of Anesthetists in Quebec by Age and by Sex, 1998/99

AGE	Head Count			$ Average Earnings 1998/99			Average FTE		Female % Male
	Male	Female	Total	Male	Female	Total	Male	Female	
25-29	11	8	19	150787	121536	138471	0.84	0.68	81 %
30-34	35	20	55	187051	135482	168299	1.04	0.75	72 %
35-39	78	39	117	227571	159157	204766	1.26	0.88	70 %
40-44	67	19	86	224810	197358	218745	1.25	1.10	88 %
45-49	39	23	62	204077	186916	197711	1.13	1.04	92 %
50-54	42	9	51	205640	189312	202759	1.14	1.05	92 %
55-59	37	5	42	213152	263761	219177	1.18	1.47	124 %
60-64	51	4	55	168633	184461	169784	0.94	1.02	109 %
65-69	21	1	22	90757	…	…	0.50	…	…
70-74	12	3	15	101544	107335	106177	0.56	0.60	106 %
75+	5	0	5	111089	n.a.	111089	0.62	n.a.	n.a.
TOTAL	**398**	**131**	**529**	**195429**	**168931**	**188966**	**1.09**	**0.94**	**86 %**

… too few to show data
n.a. not applicable

The numbers from Quebec show the influence of the demographic characteristics, age and sex, on labour force behaviour. The data confirm once again, several enduring phenomena that should be taken into consideration in planning models:

> As with the data for Alberta, average workload diminishes significantly for the very oldest anesthetists. The pattern for men is to have the heaviest workloads between the ages 35-44. In 1998/99, male anesthetists in Quebec were, on average, performing the work of 1 ¼ FTE anesthetists each. Those aged 45-59 were also, on average, working well above the value of I FTE each. From age 60 onwards, male anesthetists' average workload starts dipping below 1 FTE each. What is, perhaps, surprising is how high the average workload of the very oldest physicians was in 1998/99. Even the small numbers who were aged 70+ were contributing, on

average, the equivalent of ½ of an FTE each. Altogether, the average workload of anesthetists in Quebec in 1998/99 was very high indeed.

Because of the expected increased feminisation of the medical profession, the work patterns of women are particularly interesting. At all ages until the age of 55, women had lighter workloads than men. The differences between men and women were greatest in the youngest age groups. For example, between the ages of 30-39, on average, women worked 70% as much as men did. From age 45 onwards, the average workload of women increased somewhat compared with the workloads of women in the prime child-rearing age groups. The very highest workloads of all were recorded for women aged 55-59, even higher than those for men aged 30-39. Because of the very small number of female anesthetists in that age group (only 5), perhaps too much should not be read into the very high average FTE ratio of 1.47. However, the ratio does indicate that older women who remain in practice do have higher workloads than men of the same age. At the present time there are very few women in these older age groups and it will be at least another 10 years before the number of older female anesthetists start increasing in number significantly.

A word about the average workload of anesthetists aged 25-34: Readers will recall the discussion related to the difference between statistics collected at a single point in time and those collected over an entire year. The average workload of the youngest anesthetists reflects the fact that the incoming group (those entering practice for the first time in the province who are among the youngest in practice) do not earn over the entire year. Because workload for Quebec is measured as a function of earnings, those who worked part-year are recorded with lower average workloads even though they may be working at the same level as those who were present in practice for the entire year. For this reason, we cannot be sure that the average workloads of those aged 25-29 or some of those aged 30-34 are indeed much lower than the workloads of those aged 35-39 and 40-44. If we look at the figures for Alberta, which are computed on the basis of reported hours of work, we do not see lower workloads among 30-34 year olds. In fact, in Alberta, 30-34 year olds had the very highest average workloads. These differences in the statistics from Alberta and Quebec also illustrate how important it is to understand the data source and its limitations in interpreting data.

What is the significance of these differences in workload for the planning model? One of the more interesting findings from the data on workload has been the insight it has provided into how the workforce adapts its behaviour to meet growing demand in the context of slowing or diminishing supply. We have already seen that in both Ontario and Quebec, the data suggest that shortages have been partially met by anesthetists assuming heavier workloads. Can this claim be better substantiated with data measuring workloads over two different time periods sufficiently far apart that we can be sure that the earlier period preceded currently experienced shortages? The data set from which the Quebec statistics were derived provides such a comparison.

A comparison of the workloads of anesthetists in Quebec in 1988/89 and 1998/99 produced the following results:

Table 14
Comparison of Workloads of Quebec Anesthetists in 1988/89 & 1998/99

Data Category	Sex	1988/89	1998/99
Anæsthetists: Head Count (from billings data)	Male	464	398
	Female	97	131
Average Earnings/ 1988/89 adjusted to 1998/99 prices (from billings data)	Male	$ 154612	$ 195429
	Female	$ 129211	$ 168931
Workload Ratio 1998/99 Compared With 1988/89 (calculated from data above)	Male	126.4	
	Female	130.7	
Average Workload Expressed in FTEs	Male	0.86	1.09
	Female	0.72	0.94

Nothing could illustrate more starkly the influence of changed circumstances on workforce behaviour than the data from Table 14. In 1988/89, Quebec had 561 anesthetists, but only 529 in 1998/99, 10 years earlier. The 6% drop in the absolute head count of anesthetists was accompanied not by a large decline in the amount of anesthesia services delivered, but rather in a considerable increase. The average workload for men went from 0.86 of an FTE to 1.09 of an FTE. For women, the average workload went from 0.72 of an FTE to 0.94 of an FTE. Men increased their workload by an average 26%; women increased theirs by 31%. Interestingly the differential between men and women stayed almost the same. In 1988/89, women worked on average 84% as much as did men. In 1998/99, on average, women worked 86% as much as men. If we calculate the total impact in terms of FTEs, we find that

In 1988/89, 464 males performed the work of 399 FTEs; 97 females, 70 FTEs
In 1998/99, 398 males performed the work of 432 FTEs; 131 females, 123 FTEs
In sum, the 561 anesthetists of 1988/89 delivered the workload of 469 FTEs, whereas the 529 anesthetists of 1998/99 delivered the workload of 555 FTEs.

Looking at such numbers could easily lead to doubts about any planning methodology. If workloads can fluctuate to such an extent, is it possible to make rational decisions about how many physicians are required or how many need to be educated? If we examine more closely the conditions surrounding the practice of medicine in Quebec at the 2 time periods compared above, perhaps the numbers won’t look so surprising after all. In 1988/89, there was a widespread belief that there was a physician surplus. There certainly was not the scarcity apparent today. It is difficult retrospectively to assess the role of the income caps designed to control costs that used to be in place, but they must have had some influence on the amount of work done by individual physicians.

Perhaps the most useful lessons we can learn from these data are 1) Physicians respond to the demand for their services by either working less in times of adequacy of physician supply and increase their workload in times of scarcity. This seems obvious when one thinks about it. What is troubling is that with the current workloads of anesthetists being as high as they are, the point must arrive (or perhaps has already arrived), when anesthetists either cannot or will not increase their workloads any further. 2) The encouraging implications of the data are that the “dangers” associated with oversupply are exaggerated. Just as anesthetists increase their workloads in a shortage situation, so will they reduce their workloads should the supply situation ease up. 3) In a planning model, although an FTE may be specified as a constant, the actual amounts of work done by anesthetists must be treated as a variable. Once a statistically acceptable measurement of workloads has been introduced, it is one of the variables that needs regular updating from time to time. Indeed, the direction of movement of average workloads, controlled for the changing age and sex distribution of the anesthetist workforce, can itself be taken as an indicator of whether physician supply is easing or worsening in relationship to demand. When average workloads increase, we can conclude that the supply situation is tightening; when average workloads decrease, we can conclude that the supply situation in relationship to demand is easing.

A “Best” Estimate of Demand for anesthetists in the Year 2016

In the previous section, we used the model to calculate the demand for anesthetists in the year 1999 and to compare the projections with the supply situation in 1999. We were able to compare requirements calculated in FTEs with head counts and the FTEs delivered by the head count number of anesthetists and G.P.s in 3 provinces. From those calculations, the conclusion was reached that there are moderate shortages of anesthetists in Quebec and Ontario and a small shortage in Alberta. For lack of data, precise calculations could not be made for the rest of Canada. Nevertheless, it can be concluded that although the magnitude of shortages cannot be computed for the other provinces, there is, with the possible exception of British Columbia, currently a shortage, of varying severity, of anesthetists in Canada.

Our next task is to use the projection of requirements for anesthetists in 2016 to discuss the parts of the planning model that deal with physician supply in the future. The final table in this part of the report selects from the range of projections provided for 2016, the set of numbers to which the analysis of future supply will be addressed.

Table 15
Anesthetists Required in the Year 2016 by Province
(Expressed in Full-time Equivalents)

Province	FTEs for Clinical Services	FTEs for Non-clinical Services	Total FTEs
Newfoundland	43	6	49
Prince Edward Is.	12	1	13
Nova Scotia	81	14	95
New Brunswick	63	4	67
Sub-tot. (Maritimes)	(156)	(19)	(175)
Québec	650	80	730
Ontario	1155	150	1305
Manitoba	97	14	111
Saskatchewan	85	9	94
Alberta	294	31	325
British Columbia	436	30	466
Territories	9	1	10
CANADA	**2925**	**340**	**3265**

The figures in Table 15 can be thought of as a "best" estimate of requirements in the year 2016 at this time. By no means should these figures be thought of as definitive. For each province they could be a starting point for reflection on the future. In this report, they will provide the starting point for examining whether the current inflows into and outflows from practice are sufficient to ensure an adequate supply of anesthetists in the future.

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8) Future Supply

Before looking at statistics related to flows of anesthetists, we will examine some statistics related to the stock of anesthetists in the most recent years. The statistics will provide data on the age and sex distribution of anesthetists by province and also examine how many were educated in Canada and how many were educated abroad. Some of the data series come from the database of the Canadian Medical Association and some from the Canadian Institute for Health Information. Included in the tables are some special tabulations produced from the CMA database that enabled more detailed disaggregations of data than are available in published statistical series.

- **Trends in Number of Anesthetists, 1986-1999**

Table 16 provides an overview of the evolution of numbers of anesthetists in the last 15 years by province. A great deal could be said about these data, but because the emphasis in this section is on the future and not the past, remarks will be restricted to a few observations relevant to a planning model for anesthesia. The first observation is that, if the data series reflects reality, the number of anesthetists has increased quite substantially between 1986 and 1999 (CIHI series).

Table 16
Number of Anesthetists in Canada by Province, 1986 – 1999

YEAR	Series	CDA	NF	PEI	NS	NB	QC	ON	MB	SK	AB	BC	TR
1986	CIHI	1837	23	3	61	29	489	699	72	42	146	273	0
1987	CIHI	1920	23	4	69	30	509	732	75	52	148	278	0
1988	CIHI	1997	24	4	69	30	541	771	76	51	152	279	0
1989	CIHI	2043	24	5	70	31	540	788	78	58	165	284	0
1990	CIHI	2059	25	5	69	29	541	801	77	57	171	284	0
1991	CIHI	2087	24	5	72	29	547	810	82	60	172	286	0
1992	CIHI	2133	29	4	69	31	553	809	90	60	183	305	0
1993	CIHI	2153	31	4	73	35	557	804	95	61	187	306	0
1994	CIHI	2181	31	6	74	34	561	820	94	64	185	312	0
1995	CIHI	2191	30	5	76	39	553	823	93	67	189	316	0
1996	CIHI	2240	36	5	81	40	556	843	98	64	190	326	1
1997	CIHI	2233	36	5	78	40	552	832	102	63	195	329	1
1998	CIHI	2283	36	5	83	42	565	847	95	66	202	341	1
1999	CIHI	2332	32	6	91	45	567	867	95	65	211	352	1
1999	CMA	2266	36	6	86	43	555	839	97	62	199	342	1
2000	CMA	2287	34	6	92	44	549	846	95	61	209	350	1

Notes:
CIHI—Canadian Institute for Health Information
CMA—Canadian Medical Association

The CIHI data series give stock counts on 31 December of each year.
The CMA data series give stock counts on 1 January each year.

To compare the CIHI numbers with CMA numbers, compare 1998 CIHI data with 1999 CMA data and 1999CIHI data with 2000 CMA data.

- **How Accurate are the Annual Stock Counts of Anesthetists?**

Overall, the number of anesthetists increased 27% over a 13-year period. More than half of the increase in numbers occurred in the first 5 years. Except for Quebec, (which is reported to have had a 16% increase in numbers) and Ontario, (for which a 24% increase in numbers is reported), all other provinces show considerably higher rates of increase. These rates are 39% for Newfoundland, 50% for P.E.I., 49% for Nova Scotia, etc. However, we have already established that the head counts of anesthetists reported for Ontario and Quebec in the CMA data series look suspiciously high compared with the numbers billing over an entire year. The CIHI numbers are even higher than the CMA numbers. Readers should study the differences between the counts for 1998 and 1999 derived from the CIHI and CMA data series. The figures are given in Table 16. Because so many studies and so many decisions about physician workforce policy are based entirely on the national statistical series, we need to return to the discrepancies between the numbers derived from billings data and the stock data from the principal national databases.

The 1998/99 billings data for Ontario and Quebec showed Ontario had 805 anesthetists who billed for services at any time over the entire year and Quebec had 529 anesthetists who billed at least once during the entire year. Because the billings data count a person even if they bill only once at any point in a year, and the stock figures count on a single day in the year, the billings data invariably count more physicians over a year than would be in practice on any single day in the year. In short, the numbers in the stock series, should be lower than the numbers in the billings series. Why then, are the stock figures higher and what does this say about the quality of the data planners have to work with?

One possible explanation of the difference is that the stock figures include physicians who do not deliver clinical services as part of their professional practice. However, this alone does not seem sufficient to account for the size of the discrepancies between the data sets. Because the quality of the data is crucial to a useful planning model, it seems essential to try to understand the source of discrepancies so that planners are aware of the problems and can take them into consideration in performing their work. Because the data set for Quebec used in this study provides an age breakdown, it is possible to compare the numbers for Quebec in a more detailed way to see if we can identify the source of discrepancies. Data were not available (at the time the study was being conducted) to do this for Ontario, but such an examination should take place in all the provinces that have data on physicians derived from the billings system.

Table 17
Number of Anesthetists in Quebec in 1998/99 by Age
(Comparison Between RAMQ and CIHI Data)

<table>
<tr><th>AGE</th><th>RAMQ</th><th>CIHI</th><th>Difference

(RAMQ - CIHI)</th></tr>
<tr><td><30</td><td>19</td><td>9</td><td>+10</td></tr>
<tr><td>30-39</td><td>172</td><td>156</td><td>+16</td></tr>
<tr><td>40-49</td><td>148</td><td>146</td><td>+2</td></tr>
<tr><td>50-59</td><td>93</td><td>98</td><td>-5</td></tr>
<tr><td>60-64</td><td>55</td><td>58</td><td>-3</td></tr>
<tr><td>65-69</td><td>22</td><td>55</td><td>-33</td></tr>
<tr><td>70-74</td><td>15</td><td>29</td><td>-14</td></tr>
<tr><td>75-79</td><td rowspan="2">5</td><td>11</td><td rowspan="2">-9</td></tr>
<tr><td>80+</td><td>3</td></tr>
<tr><td>Total</td><td>529</td><td>565</td><td>-36</td></tr>
</table>

The data in this little statistical table are of very great significance, not just for the specialty of anesthesia, but also for all users of physician stock data. The billings data are complete and not subject to time delays in recording, etc., so we can have full confidence in them. (At this point, readers might find it helpful to refer back to the section of the report explaining the differences between stocks and flows and the problems related to time delays in recording flows into and out of the system.) The figures in Table 17 illustrate these problems in about as clear-cut a fashion as could be imagined. ***The stock figures undercount young anesthetists and heavily over count older ones.*** The discrepancies between the RAMQ and CIHI numbers are not evenly spread across age groups. This alone proves that the differences are not due to the omission in the counts of physicians who do not deliver clinical services. The differences arise largely in the age groups of the under 39s and those aged 65+. These are precisely the age groups in which the flows into and out of the system are concentrated, inflows among the young, outflows among the old. CIHI reported 98 anesthetists aged 65+ in Quebec on 31/12/98. Yet, during the entire 1998/99 fiscal year, only 56 anesthetists aged 65+ billed for at least 1 service during the year! If, as is most probable, the other 42 (or most of them) had already retired, the data series is seriously over counting the number of older physicians in practice. Similarly, the official data series quite significantly under states the number of entering, young physicians. The magnitude of these data errors and their concentrations, precisely in the incoming and outgoing segments of the physician population, tells us that traditional workforce planning is seriously hampered by the inadequacies of the quality of the flow data. How many anesthetists are there in the provinces of Quebec and Ontario? The answer is, in spite of all the existing data, we really don't know. We can conclude, however, that if the CIHI numbers for the 2 largest provinces are too high by approximately 80 persons, the total count for Canada must be too high also.

It is impossible to say whether the data for other provinces are affected to the same extent as the figures for Quebec reported in Table 17. However, the CMA data series seems to be produce figures that are closer to the billings data than do CIHI's numbers, so they will be used in the more detailed breakdowns to be used in what follows.

- **Age/Sex Distribution of Anesthetists by Province, 1999**

It is time to turn to disaggregations of the most recent stock figures to study the demographic composition of the anesthesia workforce. Table 18, derived from the CMA database, shows the number of anesthetists in Canada on 1/1/2000 by province, age and sex. The data show that there were 2287 professionally active anesthetists in Canada at the beginning of the year 2000. Of these, 23% were women and 11% were aged 65 years or older. According to the data, Quebec had the largest number of anesthetists of retirement age who were still professionally active, 16.4% of Quebec's anesthetist complement. However, we should keep in mind that the billing data showed only 42 anesthetists aged 65 or older billed for services, whereas the CMA data show 90 anesthetists aged 65 or older. Other provinces with relatively large numbers of anesthetists at or close to retirement age are New Brunswick and Ontario, though the figures for Ontario may well be overstated also.

The most relevant points related to workforce planning that come to mind when examining these data are 1) that feminisation has proceeded at a slower pace than might have been expected based on the proportion of women earning medical degrees in the last 25 years in Canada. Only ¼ of the anesthetists in Quebec are female, even though Quebec has been graduating more women than men from its medical schools for many a long year. 2) There are fewer anesthetists than there ought to be in the younger age cohorts, if the anesthetist pool is to renew itself as retirements occur and increase in line with increasing demand for anesthesia services. The statistics report fewer 35-44 year olds than 45-44 years olds. There appear to be far too few anesthetists aged less than 35. We know that the true figure is higher than what is reported in the statistics (see discussion above), but there is no way of assessing the extent of the under count of recent entrants to practice. The statistics probably mean that the rate of entry into practice in recent years has been low or that retention rates in practice are low or that both entry rates and retention are low.

Table 18
Number of Anesthetists by Province, Age & Sex, CANADA 1/1/2000

Age	PROVINCE											CN
	Nfld.	PEI	NS	NB	QC	ON	MB	SK	AB	BC	TR	
MALE												
<35	1	2	6	4	27	42	6	0	10	11	0	**109**
35-44	13	1	20	11	141	179	23	19	56	79	1	**543**
45-54	11	1	26	8	86	210	30	13	73	111	0	**569**
55-64	1	1	16	3	75	124	11	6	18	64	0	**319**
65+	1	1	5	6	82	85	8	2	12	20	0	**222**
Total	**27**	**6**	**73**	**32**	**411**	**640**	**78**	**40**	**169**	**285**	**1**	**1762**
FEMALE												
<35	1	0	4	2	23	12	2	0	2	5	0	**51**
35-44	4	0	7	7	54	58	7	13	19	25	0	**194**
45-54	2	0	5	2	41	88	5	5	17	22	0	**187**
55-64	0	0	3	0	12	32	2	3	2	11	0	**65**
65+	0	0	0	1	8	16	1	0	0	2	0	**28**
Total	**7**	**0**	**19**	**12**	**138**	**206**	**17**	**21**	**40**	**65**	**0**	**525**
TOTAL												
<35	2	2	10	6	50	54	8	0	12	16	0	**160**
35-44	17	1	27	18	195	237	30	32	75	104	1	**737**
45-54	13	1	31	10	127	298	35	18	90	133	0	**756**
55-64	1	1	19	3	87	156	13	9	20	75	0	**384**

65+	1	1	5	7	90	101	9	2	12	22	0	**250**
Total	**34**	**6**	**92**	**44**	**549**	**846**	**95**	**61**	**209**	**350**	**1**	**2287**
% F	**20.6**	**0.0**	**20.7**	**27.3**	**25.1**	**30.7**	**17.9**	**34.4**	**19.1**	**18.6**	**0.0**	**23.0**
% 65+	**2.9**	**16.7**	**5.4**	**15.9**	**16.4**	**11.9**	**9.5**	**3.3**	**5.7**	**6.3**	**0.0**	**10.9**

Source: *CMA database*

- **How Dependent is Canada on Other Countries to Provide Physicians to Deliver Anesthesia Services?**

To answer this question, we will study the statistics related to country of graduation of the existing stock of anesthetists. Table 19 shows the number of anesthetists who are graduates of Canadian medical schools and the number who are graduates of medical schools outside Canada. Figures are shown for each province and by age group.

Altogether, ¼ of all anesthetists in Canada earned their medical degree outside Canada. Two provinces, Manitoba and Quebec had relatively low rates of foreign-educated anesthetists. The rates were 10.9% for Quebec and 14.7% for Manitoba. New Brunswick had exactly ¼ of its anesthetists from abroad and all the other provinces had ⅓ or close to ⅓ of their anesthetists from abroad. By any yardstick, a dependency ratio of ⅓ would be considered high. The picture changes when we look at the proportion of anesthetists who are graduates of foreign medical schools by age. Here we find that the graduates of foreign medical schools are disproportionately concentrated in the 2 oldest age groups. Among anesthetists aged 55-64, 46% earned the M.D. or equivalent degree outside Canada. Among those aged 65+, the % was 42%. In fact, the proportion of graduates of foreign medical schools in the age group 45-54 was 26% and it was 13% among anesthetists aged 35-44. The % was even lower among those aged less than 35, but that is to be expected, because it is usually a number of years after qualifying that physicians immigrate to Canada, so people in the youngest age groups haven't arrived from abroad yet.

Table 19A
Number of Anesthetists by Province and Age, CANADA, 1/1/2000

Province	Number of Anesthetists					Total
	Aged <35	Aged 35-44	Aged 45-54	Aged 55-64	Aged 65+	
Newfoundland	2	17	13	1	1	**34**
P.E.I.	2	1	1	1	1	**6**
Nova Scotia	10	27	31	19	5	**92**
New Bruns.	6	18	10	3	7	**44**

Quebec	50	195	127	87	90	**549**
Ontario	54	237	298	156	101	**846**
Manitoba	8	30	35	13	9	**95**
Saskatchewan	0	32	18	9	2	**61**
Alberta	12	75	90	20	12	**209**
Br. Columbia	16	104	133	75	22	**350**
Territories	0	1	0	0	0	**1**
CANADA	**160**	**737**	**756**	**384**	**250**	**2287**

Source: *CMA database*

Table 19B

Graduates of Canadian Medical Schools, Canada 1/1/2000

Province	**Number of Anesthetists: Graduates of Canadian Medical Schools**					**Total**
	Aged <35	**Aged 35-44**	**Aged 45-54**	**Aged 55-64**	**Aged 65+**	
Newfoundland	2	14	7	0	0	**23**
P.E.I.	2	1	1	0	0	**4**
Nova Scotia	10	21	19	10	3	**63**
New Bruns.	6	18	5	1	3	**33**
Quebec	50	190	117	62	70	**489**
Ontario	50	195	209	69	51	**574**
Manitoba	8	27	30	10	6	**81**
Saskatchewan	0	27	13	4	1	**45**
Alberta	12	63	63	10	2	**150**
Br. Columbia	15	82	97	43	10	**247**
Territories	0	1	0	0	0	**1**
CANADA	**155**	**639**	**561**	**209**	**146**	**1710**

Table 19C

Graduates of Foreign Medical Schools, CANADA, 1/1/2000

Province	**Number of Anesthetists: Graduates of Foreign Medical Schools**					**Total**
	Aged <35	**Aged 35-44**	**Aged 45-54**	**Aged 55-64**	**Aged 65+**	
Newfoundland	0	3	6	1	1	**11**
P.E.I.	0	0	0	1	1	**2**
Nova Scotia	0	6	12	9	2	**29**
New Bruns.	0	0	5	2	4	**11**
Quebec	0	5	10	25	20	**60**
Ontario	4	42	89	87	50	**272**
Manitoba	0	3	5	3	3	**14**

Saskatchewan	0	5	5	5	1	**16**
Alberta	0	12	27	10	10	**59**
Br. Columbia	1	22	36	32	12	**103**
Territories	0	0	0	0	0	**0**
CANADA	**5**	**98**	**195**	**175**	**104**	**577**

Source: *CMA database*

The numbers tell us that Canada was extremely dependent on anesthetists from other countries until the mid '70s (people who would be approximately 55 years of age and older now) and that since that time Canada's degree of self-sufficiency has been much greater. The data are consistent with the fact that from the mid-'70s onwards, restrictions on the entry of physicians from other countries were introduced in Canada.

- **Representation of Different Graduating Cohorts in the Anesthesia Workforce**

Before turning to the problems associated with computing flows into and out of the system, let us take a look at the composition of the anesthesia workforce in terms of the contribution of different graduating cohorts to the total workforce. Such data show trends in the proportion of each graduating class that chose anesthesia as their field of practice. The columns of data in Table 20 are explained briefly:

The pool of anesthetists in Canada on 1/1/2000 is disaggregated to show the numbers by the year in which they earned the M.D. degree. The numbers are further divided by the country in which the M.D. degree was earned, either Canada or any other country. Because we know how many M.D. degrees Canadian universities awarded each year, we can calculate the proportion of each year's graduates who are practising in the specialty of anesthesia. Readers should keep in mind that it now takes at least 5 years from graduation from medical school to complete training in anesthesia to the point of specialty certification. Thus, there were no medical graduates of 1995 or any later year fully qualified as anesthetists on 1/1/2000. To put the data in perspective, a column is included that reports the number of years that have elapsed since the anesthetists completed medical school. When studying the final column in the table, which reports the proportion of each graduating class in anesthesia at the beginning of the year 2000, it must be remembered that the numbers are people who are still in anesthesia after the passage of however many years it may be since they started practising. Because of attrition for any of a variety of reasons, the longer the elapsed time since the commencement of practice, the fewer people we expect to find in practice.

As we would expect from the age distributions reported earlier, the data in this table confirm that graduates of foreign medical schools are high proportions of the early graduating cohorts still in practice. However, the main interest of these data is graduates of Canadian medical schools who have chosen anesthesia as their field of practice.

If we study the numbers of graduates from each graduating year, we can distinguish 3 more-or-less similar time periods. We see that for graduates who earned their medical degrees from 1965 to 1975, the approximate number of anesthetists in practice on 1/1/2000 was around 30 for each of the years. The range was a low of 18 for graduates of 1966 to a high of 46 for 1974. For graduates of the years 1976 to 1986, the contribution to the anesthesia workforce was much higher. The range goes from 62 for graduates of 1976, 1978 & 1979, to a high of 92 for the class of 1981. If we look at these statistics in terms of the % of the graduating cohort, we find that 5.2 % of the class of 1981 were active in anesthesia 19 years after they graduated from medical school. It is in this light that the figures for the most recent years are

Table 20
Anesthetists in Canada by Year of Graduation, Country of Graduation and Proportion of Each Year's Graduating Cohort Practising Anesthesia, 1/1/2000

Year Of Grad.	Years Since M.D.	Country of Graduation			% of Grads.		M.D.s Awarded Canadian Univ.	% Gocms in Anæs. 1/1/2000
		Canada	Abroad	Total	Gocms	Gofms		
<1965	>34	205	171	376	54.5	45.5	n.a.	n.a.
1965	34	29	18	47	61.7	38.3	1032	2.8
1966	33	18	11	29	62.1	37.9	882	2.0
1967	32	22	25	47	46.8	53.2	918	2.4
1968	31	19	20	39	48.7	51.3	1016	1.9
1969	30	23	19	42	54.8	45.2	1018	2.3
1970	29	33	22	55	60.0	40.0	1074	3.1
1971	28	30	19	49	61.2	38.8	1133	2.6
1972	27	32	24	56	57.1	42.9	1278	2.5
1973	26	26	18	44	59.1	40.9	1328	2.0
1974	25	46	26	72	63.9	36.1	1560	2.9
1975	24	39	21	60	65.0	35.0	1544	2.5
1976	23	62	15	77	80.5	19.5	1714	3.6
1977	22	67	14	81	82.7	17.3	1691	4.0
1978	21	62	19	81	76.5	23.5	1755	3.5
1979	20	62	23	85	72.9	27.1	1760	3.5
1980	19	74	23	97	76.3	23.7	1742	4.2
1981	18	92	16	108	85.2	14.8	1765	5.2
1982	17	83	8	91	91.2	8.8	1756	4.7
1983	16	86	8	94	91.5	8.5	1794	4.8
1984	15	71	9	80	88.7	11.3	1773	4.0
1985	14	64	7	71	90.1	9.9	1835	3.5
1986	13	68	10	78	87.2	12.8	1758	3.9
1987	12	54	11	65	83.1	16.9	1766	3.1
1988	11	59	9	68	86.8	13.2	1781	3.3

1989	10	43	4	47	91.5	8.5	1722	2.5
1990	9	48	5	53	90.6	9.4	1708	2.8
1991	8	43	0	43	100.0	0.0	1704	2.5
1992	7	37	2	39	94.9	5.1	1749	2.1
1993	6	60	0	60	100.0	0.0	1702	3.5
1994	5	53	0	53	100.0	0.0	1686	3.1
Total		**1710**	**577**	**2287**	**74.8**	**25.2**		

Source of data: *Canadian Medical Association*

Graduation refers to M.D. or equivalent first professional degree in medicine. M.D.s Awarded by Canadian Universities refers to the total number of M.D. degrees awarded in each year from 1965 to 1994. There were no anesthetists in practice on 1/1/2000 who earned the M.D. later than 1994. ***If we look at the figures for the graduating classes of 1988 to 1994, we are bound to ask the question: Where are the anesthetists from these graduating classes?*** We would expect to find at least 4% of the graduates of the most recent years active in anesthesia, but they aren't there. For the graduates of 1993 and 1994, a few may still be in training, so we can expect the contribution of those graduating cohorts to contribute further to the anesthesia pool in the next year or two. Some may not yet be recorded on the national physician databases yet. In spite of this, the hypothesis has to be entertained that what we are seeing in these low numbers is the impact of the brain drain of Canadian physicians of the '90s on the anesthesia workforce. Data will shortly be shown on the number of specialty certificates in anesthesia issued in recent years. When comparing the certification data with the numbers in practice, the magnitude of the differences between the numbers qualifying and the numbers in practice will be appreciated.

- **Flow Data**

Ideally it would be possible to produce data series giving computations for all the relevant components of flows of anesthetists into and out of practice, but lack of data makes this impossible. For some of the components, data could be secured with effort. For others, at the present time credible data series do not exist. Because of lack of data, proxy measurements have to be used instead. For example, we use the number of certificants in anesthesia as a proxy measurement of numbers of entrants into practice. However, knowing the proportion of certificants who do actually enter practice is critically important, especially if there is considerable leakage from the system. It is important to be able to calculate retention rates over time. If decisions are necessary on how many new anesthetists have to be educated, the ultimate goal, of a physician workforce plan, we need to know how many anesthetists we want at the target date and how many from the current stock will have departed by the target date. With those 2 bits of information, we can figure out how many need to be either educated in Canada or imported from abroad by the target date. Age is used to estimate the number of retirements. Estimating retirements is the easy part of estimating outflows. What is difficult is estimating premature departures (e.g., emigration, abandoning medicine as a profession). The remainder of this section will deal with statistics from the training system to see if we can fill in some of the gaps in the flow statistics by using the educational statistics.

- **Output of Canadian Training Programmes in Anesthesia**

It is only since 1980 that systematic data have been collected on Post-M.D. training programmes in Canada. It was not until all training came under the ægis of universities that regular statistics were collected. For this reason, the data series do not go back very far in time. It is important to have some idea of how the capacity of training programmes has changed over time and of the number of physicians who have been trained as anesthetists to try to get some idea of the relationship between the number educated and the number who practise in Canada.

Tables 21 and 22 show enrolment in anesthesia training programmes. The first of the 2 tables distributes enrolment by rank and the second distributes enrolment by sex and by legal status in Canada of the trainees.

To derive the most information from Table 21, a few points should be noted. Rank is not as precise a measurement of the stage reached in an educational programme, as is year of study in a university degree programme. Especially in years gone by, rank was frequently based on the number of years of training a person might have done previously rather on the stage reached in the training programme. Originally, ranks were introduced for payment purposes and not for measuring academic progress. Since, it used to be pretty easy to switch training programmes, a trainee could be at R-3 rank, but be in the first year of a specialty training programme. We are mainly interested in the numbers of trainees enrolled in the final ranks as indicators of the output of the programmes, and numbers enrolled in year 1 as a leading indicator of future output.

Another point that must be kept in mind is that until 1997, R-4 was the rank at which trainees took the certification examinations. Thus trainees listed under R-4 in 1987/88 probably took their certification examinations in 1988 and, if successful, entered practice in 1988. From 1998 onwards, this changed. For trainees in 1997/98, some of those at R-4 and all at R-5 were ready to take the certification examinations in 1998.

Table 21
Post-MD Trainees in Anesthesiology by Rank, CANADA, 1980/81 – 1999/00

YEAR	RANK							TOTAL
	R1	R2	R3	R4	R5	Other	Fellow	
1999/00	92	89	83	83	97	3*	93	**540**
1998/99	81	80	87	93	84	0	79	**504**
1997/98	73	85	96	100	66	0	64	**484**

1996/97	73	100	113	93	53	0	81	**513**
1995/96	84	124	94	97	30	0	64	**493**
1994/95	84	149	90	82	40	0	49	**494**
1993/94	140	84	79	88	15	0	40	**446**
1992/93	84	87	80	85	16	0	27	**379**
1991/92	74	78	74	113	4	0	22	**365**
1990/91	74	86	95	93	16	0	24	**388**
1989/90	76	97	79	110	24	0	22	**408**
1988/89	103	72	92	101	17	0	26	**411**
1987/88	74	95	93	117	19	0	28	**426**
1986/87	87	92	111	130	8	1	25	**454**
1985/86	86	105	115	120	14	4	26	**470**
1984/85	84	112	100	114	15	3	29	**457**
1983/84	94	117	97	110	10	3	24	**455**
1982/83	92	108	84	94	9	4	20	**411**
1981/82	..	..	..	..	..	..	..	**386**
1980/81	75	76	102	85	13	0	16	**367**

Source: *"Canadian Medical Education Statistics" Annual Editions, ACMC*
* = R6
.. = Data not available

This arose out of the reorganization of Post-M.D. training following the elimination of the rotating internship a few years earlier and the lengthening of training programmes. From 1998/99 onwards, trainees at R-5 are in the final year of anesthesia training.

Table 21 shows that the total number of trainees in anesthesia has shown considerable expansion over the years. Altogether, there are 47% more trainees in anesthesia programmes than there were 19 years earlier. This would be quite misleading as an indicator of the output of anesthetists for practice in Canada. Most of the trainees listed under the column "fellows" are physicians- in –training from other countries on relatively short-term foreign student visas (referred to as visa trainees in what follows). Even among trainees in regular trainee positions leading to the certification examinations, there are visa trainees who do not have the automatic right to stay in Canada to practise medicine when their training is completed. Most of them are trainees sponsored by their own governments who are contracted to return to their home countries when training is completed. Thus, not all of the outputs of training programmes are available for practice in Canada.

The data cover trainees who would have entered practice in Canada in the last 20 years or so. We have already seen that the full complement of practising physicians was educated over a much longer time period than this. Even for this relatively short time series, we notice sizeable fluctuations in the numbers at the final stages of training. In 1986/87, there were as many as 130 R-4s; in 1994/95, as few as 82. Given the ups and downs in the numbers completing training each year, it is not surprising that the numbers entering practice each year are not based on perceived need, but go up and down in line with fluctuating outputs.

What is striking, is that the numbers in the final years of training programmes are much higher than the numbers in practice from the corresponding graduation cohorts. This demonstrates a serious retention problem. To the extent that there are shortages of anesthetists, the retention rate of those trained in Canada appears to be a major contributory factor.

The numbers enrolled in the early years of training programmes should provide a leading indicator of what is coming through the pipeline. To a certain extent they do, but anyone looking closely at the numbers in Table 21 will realize that this applies to a limited extent only. Take for example, the year 1988/89. In 88/89 there were 103 trainees ranked R-1; in 89/90, there were 97 trainees ranked R-2; in 90/91, there were 95 trainees ranked R3 and in 91/92, we suddenly have 113 trainees! It is difficult to make sense of such numbers and the only reasonable explanation is that the ranks were not as useful an indicator of stage reached in the training programme as might be desired. Keeping this in mind, we see that there were 92 trainees enrolled at the R-1 level in 1999/00, a considerable increase over the previous few years. It remains to be seen whether this new higher level of entry into anesthesia programmes will be maintained in the future. In general, we should note the low level of intake into anesthesia programmes in 1995/96 and in 1996/97, the lowest over the 20-year period studied.

In Table 22, we look briefly at the demographic characteristics of trainees over the years. The principal finding with respect to the number of women trainees is that women now form just over ⅓ of trainees. Projections of future supply, should assume that by 2016, approximately 30 % of practising anesthetists will be women.

Table 22 shows that over the years, the proportion of visa trainees has grown. Their numbers need to be subtracted from any estimates of physicians available to practice in Canada.

Table 22
Post-MD Trainees in Anesthesia by Legal Status and Sex, CANADA, 1980/81 – 1999/00

YEAR	Legal Status in Canada		TOTAL	SEX	
	Cit. & L.I.	Visa		Male	Female
1999/00	463	77	540	356	184
1998/99	442	62	504	335	169
1997/98	431	53	484	337	147
1996/97	457	56	513	345	168
1995/96	449	44	493	341	152
1994/95	455	39	494	343	151
1993/94	403	43	446	318	128
1992/93	342	37	379	275	104
1991/92	329	36	365	268	97
1990/91	352	36	388	289	99

1989/90	371	37	408	312	96
1988/89	382	29	411	310	101
1987/88	393	33	426	323	103
1986/87	416	38	454	346	108
1985/86	428	42	470	361	109
1984/85	408	49	457	353	104
1983/84	407	48	455	346	109
1982/83	367	44	411	304	107
1981/82	337	49	386	286	100
1980/81	320	47	367	264	103

Source : *CAPER & ACMC*

Before leaving this section on outputs from the training system, it is perhaps worthwhile to raise one more often ignored issue. This is the age at which trainees complete training and the relationship of this with the number of years of professional service they can be expected to provide before retiring.

- **Age at Completion of Training and Length of Professional Working Life.**

For various reasons, over the years the age at which students have been admitted to medical school has increased. Concomitantly, the age at graduation has also increased. The length of training programmes has increased by a year recently. All this has meant that the professional working life of physicians has diminished, implying a need to renew the stock at a more rapid rate. Table 23 examines this issue for the 92 trainees who completed anesthesia training in a Canadian university in 1999.

Table 23
Age at Completion of Post-M.D. Training in Anesthesia and Expected Duration of Professional Life. (Trainees Who Completed Training in Canada in 1999)

Age	GOCMS		GOFMS	Total	Years to Age 65	Total Years	GOCMS		GOFMS
	Direct Entry	Re-entry					Direct Entry	Re-entry	
28	6	0	0	6	37	222	222	0	0
29	7	0	0	7	36	252	252	0	0
30	18	0	0	18	35	630	630	0	0
31	10	0	0	10	34	340	340	0	0
32	15	2	0	17	33	561	495	66	0
33	3	1	1	5	32	160	96	32	32
34	3	2	1	6	31	186	93	62	31
35	3	0	1	4	30	120	90	0	30
37	2	0	1	3	28	84	56	0	28

38	3	1	1	5	27	135	81	27	27
39	0	0	1	1	26	26	0	0	26
40	2	0	0	2	25	50	50	0	0
41	1	0	0	1	24	24	24	0	0
43	1	0	1	2	22	44	22	0	22
44	0	0	2	2	21	42	0	0	42
47	0	0	1	1	18	18	0	0	18
48	0	0	1	1	17	17	0	0	17
53	0	0	1	1	12	12	0	0	12
total	**74**	**6**	**12**	**92**		**2923**	**2451**	**187**	**285**
Expected Av.Duration of Professional Life in Years →						**31.8**	**33.1**	**31.2**	**23.7**

GOCMS = Graduates of Canadian Medical Schools
GOFMS = Graduates of Foreign Medical Schools

Table 23 displays the spectrum of ages at which trainees completed their training. A distinction is made between trainees who entered anesthesia training directly from medical school and those who re-entered training after some time in practice, the impact of which is to reduce the total life-time number of years of service in anesthesia that they will be able to deliver. Because graduates of foreign medical schools do not usually enter training in Canada immediately upon graduation either, they are also shown as a separate category. The calculations are simple. The age at completion is subtracted from 65 to obtain the expected length of remaining professional life. That number is multiplied by the number of graduates who completed training at that age to obtain the total number of years of professional life for all completers at a given age. The total years are summed to obtain the lifetime contribution in years for the entire cohort. That total is divided by the number of completers in each of the categories to obtain the average expected professional lifetime in years.

Not surprisingly, trainees who entered the anesthesia training programme directly upon completion of medical school (direct-entry trainees), have the longest professional life ahead of them. It is expected to be 33.1 years. Re-entry trainees have an expected average of 31.2 years of professional service ahead of them; on average, graduates of foreign medical schools have only 23.7 years of professional service as anesthetists ahead of them. These statistics point out that the most efficient way to educate anesthetists is to recruit directly out of medical school. Failing that, the alternatives imply increased turnover and, hence, the need to educate more people in the long run. This is particularly clear with respect to training graduates of foreign medical schools.

- **Output of Royal College Certification Programmes**

An important source of data on numbers qualifying as specialists in Canada is the Royal College of Physicians and Surgeons of Canada. The RCPSC organizes and administers the examinations that lead to certification in a specialty. One other body conducts specialty examinations: the College of Physicians of Quebec (CMQ). The vast majority of candidates for CMQ examinations also seek certification from the RCPSC. When using statistics from the RCPSC, we have to keep in mind that there is some undercounting, because it has not been possible to include the data for those qualifying only through the CMQ in the statistics that follow.

Another complication in using the certification data is that until 19??, it was possible for anesthetists who were trained in a number of countries outside Canada to practise as anesthetists without further training in Canada or taking the RCPSC certification examinations. (note: get the relevant details and fill in this section with factual data when in Ottawa. Talk to Royal College) Thus, some of the qualified, practising anesthetists of earlier graduating cohorts do not have RCPSC certification, all their specialty training having taken place outside Canada. What this means is that the data given regarding the number of certificants by year of certification, if used to get an idea of the number of anesthetists coming on stream each year, undercounts the entrants into practice. This becomes a problem when we try to calculate the retention rates over the years of the number of qualified anesthetists each year. If we do not know the total numbers qualifying to enter practice (the sum of new certificants from within Canada + those accepted from abroad with recognised qualifications), we have no denominator to use in calculating retention rates.

Canadian training programmes train a number of physicians from other countries who are contractually obligated to return to their home country upon completion of training. These trainees/certificants are not available to meet the health care needs of the Canadian population and should be subtracted from the number of certificates in anesthesia awarded when examining the question of how many are qualifying to practise in anesthesia each year. There were also, in the past, some examinees of the RCPSC who did not train or intend to practise in Canada but who sat the examinations for the cachet attached to RCPSC certification. The number of certificants includes those successful candidates also.

The Canadian Post-M.D. Education Registry (CAPER) is the principal source of data on specialty education in Canada. Physicians from abroad who are qualified to sit the RCPSC examinations without doing training in Canada are not included in CAPER statistics, and for this reason the number of certificants derived from CAPER data does not tally with the number reported by the RCPSC. By subtracting the number of certificants who trained in Canada (and were included in CAPER statistics) from the RCPSC totals, we can calculate the numbers who didn’t go through the Canadian training system.

Tables 24 and 25 present the data on RCPSC certification in anesthesia. Table 24 provides data on the number of certificants who did some or all of their Post-M.D. training in anesthesia in Canada. The numbers are disaggregated by legal status in Canada at the time of training and whether or not the M.D. or equivalent degree was earned in Canada. The categories used are:1) Citizens of Canada (CC) (including graduates of foreign medical schools who had acquired Canadian citizenship by the time of registering in heir final year of training), 2) Landed immigrants (LI). This group includes those who, although not citizens of Canada, have the legal right to stay in Canada and enter practice as anesthetists, 3) Visa trainees. This group of certificants is not expected to be part of the physician workforce in Canada and cannot be counted as part of the pool of practising anesthetists in Canada. 4) Legal status unknown. The certificants so classified are the numbers who took the RCPSC examinations without training in Canada. It is presumed that they are all graduates of foreign medical schools. These detailed breakdowns by legal status and country of graduation are available only for certificants of the last 10 years.

Table 24
Number of RCPSC Certificants in Anesthesia, 1990-1999, by Legal Status in Canada at Time of Certification and Country in Which M.D. or Equivalent Degree Earned.

Year of Certif-ication	Canadian Citizens		Non-Citizens/GOFMS			GOFMS		Total
	GOCMS	GOFMS	VISA trainees	Landed Immig.	Trained Abroad	Sub-total	%	
1990	73	4	4	5	4	17	*18.9*	90
1991	70	0	5	10	3	18	*20.5*	88
1992	68	5	7	10	8	30	*30.6*	98
1993	59	5	1	8	0	14	*19.2*	73
1994	55	6	6	12	2	26	*32.1*	81
1995	59	4	0	9	3	16	*21.3*	75
1996	68	0	3	12	4	19	*21.8*	87
1997	64	7	5	5	0	17	*21.0*	81
1998	66	3	5	3	3	14	*17.5*	80
1999	75	4	3	5	0	12	*13.8*	87
1990-99	**657**	**38**	**39**	**79**	**27**	**183**		**840**
% →	78.2%	4.5%	4.6%	9.4%	3.2%	21.8%		100%

Source of Data: *RCPSC & CAPER*

From 1990-1999, a period of 10 years, 840 certificates in anesthesia were awarded by the RCPSC, an average of 84 per year. On average, 97% of the certificants had trained in Canada, 3% exclusively abroad. Only 78% of the certificants of the last 10-years were Canadian citizens who earned the M.D. degree in Canada. Given how difficult it has been in recent years for graduates of medical schools outside Canada to obtain training slots in Canada, it is a little unexpected to discover that 22% of the certificants in anesthesia from 1990-1999 had earned their medical degree abroad and that the vast majority of graduates of foreign medical schools had trained in Canada. In no year was the % of graduates of foreign medical schools les than 14% of the total. This tells us that even in the most recent time period, when all sorts of restrictions have been in operation, that anesthesia has been able to supplement the output of Canada's medical schools with a sizeable additional complement from medical schools outside Canada. Because we do not know the year of graduation (year M.D. or equivalent degree earned) of certificants who earned the M.D. abroad, we cannot calculate retention rates for them. But, making assumptions about the year of certification in relationship to the year of medical school graduation, we can do so for the 657 graduates of Canadian medical schools.

On the assumption that certificants earned the M.D. 4 years prior to certification, we can compare the number of graduates in practice on 1/1/2000 with the number of certificants of their graduating cohort. For graduates of Canadian medical schools who earned the M.D. between 1986 and 1990 and who were certified in anesthesia between 1990 and 1994, 272 out of 325 were in practice on 1/1/2000 or 84%. For certificants of the next 4 years, 1995 to 1999, 193 out of 255 graduates of Canadian medical schools were in practice on 1/1/2000 or 76%. Because of the delays in recording entering physicians on the national data bank, perhaps the retention rate is somewhat higher for this later group. Even if this is the case, it is not at all encouraging to find that so soon after certification, the retained % of anesthetists is so relatively low.

Table 25 provides a longer time series on the number of certificants, but we do not have any breakdown regarding country of medical school graduation, etc. that would enable a study of trends in the output of Canada's own training programmes. The CAPER data start in 1988 only. The one breakdown available is by sex, so we can get a good idea of the evolution in the proportion of women choosing a career in anesthesia. This longer trend table allows a better time perspective on the numbers qualifying for medical practice in the specialty of anesthesia.

To reflect on the workforce implications of the numbers reported in Table 25, we need to keep in mind, that in the year 2000, the pool of anesthetists in practice qualified roughly from 1962 onwards. Today, the youngest certificants are approximately 30 years of age at the time of certification. Those who qualified in Canada back in the '60s, were probably at least 3 years younger, on average. Most entered medical school following only 2 years of university, whereas today, a university degree is required and the training course is a year longer.

The statistics in Table 25 show very wide fluctuations from year-to-year in the number of certificants in anesthesia. The lowest number was only 42 in 1972; the highest was 118 in 1986. There is no obvious explanation for the fact that after 1971,

Table 25

Number of Certificates in Anesthesia Awarded by the Royal College of Physicians and Surgeons of Canada, 1970 –1999

Year	Certificants			Year	Certificants		
	Male	Female	Total		Male	Female	Total
1970	61	8	69	***1985***	83	17	100
1971	55	12	67	***1986***	91	27	118
1972	37	5	42	***1987***	86	21	107
1973	42	10	52	***1988***	85	29	114
1974	48	7	55	***1989***	72	29	101
1975	49	12	61	***1990***	73	17	90
1976	37	13	50	***1991***	70	18	88
1977	40	10	50	***1992***	70	28	98
1978	53	10	63	***1993***	57	16	73
1979	48	14	62	***1994***	62	19	81
1980	51	19	70	***1995***	56	19	75
1981	60	23	83	***1996***	58	29	87
1982	67	25	92	***1997***	50	31	81
1983	66	25	91	***1998***	58	22	80
1984	72	31	103	***1999***	63	23	87

	male	**female**	**total**	**% female**	**% male**
1970-75	292	54	346	15.6	84.4
1976-80	229	66	295	22.4	77.6
1981-85	348	121	469	25.8	74.2
1986-90	407	123	530	23.2	76.8
1991-95	315	100	415	24.1	75.9
1996-99	229	105	334	31.4	68.6

In addition to certificates granted by the RCPSC, there may be a few certificants of the College of Physicians of Quebec who did not seek concurrent certification with the RCPSC. Such numbers are small.

The above numbers include certificates granted to persons abroad who took the RSPSC examinations without training in Canada.

the number of certificants was much lower for a number of years, and then started rising in 1981. After 1981, the annual number of certificants rose rapidly and remained at a high level for a number of years and then decreased again. From 1984 to 1989 inclusive, the number of certificants in anesthesia exceeded 100 each year. In the most recent years, the numbers have been in the eighties, with a few cases, numbers dipping down into the seventies. These numbers have no obvious bearing on perceived workforce requirements. If the output of certification programmes did have a connection with workforce requirements, they would not exhibit such variability and fluctuation.

It would be useful to be able to compare the number of anesthetists in practice with the numbers who were granted certification, to calculate retention rates over a long time period. At this time, data are not available. It needs to be investigated whether the national physician databases carry information on the year certification was earned. If they do, it might be possible to get reasonably precise measurements of cohort based retention. In this case a cohort would be defined as the group of anesthetists that earned certification in the same year.

Because retention is such an important element in making decisions about how many anesthetists need to be trained, some approximate estimates were made of the rate of retention of trained anesthetists.

By making assumptions about the relationship between the year of medical graduation and the year of certification for graduates of Canadian medical schools and graduates of foreign medical schools, it was possible to use some of the data in Tables 20, 24 and 25 to come up with some estimates. They turned out as follows:

Medical grads. of years 1966-70, (certificants, 1970-1974) : retention to 2000, 50%
Medical grads. of years 1971-75, (certificants, 1975-1979) : retention to 2000, 70%
Medical grads. of years 1976-80, (certificants, 1980-1984) : retention to 2000, 75%
Medical grads. of years 1981-85, (certificants, 1985-1989) : retention to 2000, 80%
Medical grads. of years 1986-90, (certificants, 1990-1994) : retention to 2000, 84%
Medical grads. of years 1991-95, (certificants, 1995-1999) : retention to 2000, 76%
(For certificants of 1990-1999, rates are based on graduates of Canadian medical schools only)

The figures given above are estimates, but even so they do tell us quite a lot. We expect, under normal circumstances, that the greater the passage of time, the fewer the number of retained members of a cohort. The highest rate of retention of a cohort should be for the most recent graduates/certificants. This is not the case in the numbers reported above. The generally expected pattern holds for physicians who graduated from medical school in the years 1966 to 1985, with approximate year of certification, 4 years later. Roughly half of the anesthetists who left medical school 30-34 years ago, were still in practice in Canada; 70% of those who graduated from medical school 25-29 years ago; 75% of those who graduated from medical school 20-24 years ago; 80% of those who graduated 15-19 years ago. However, for those who graduated from medical school 10-14 years ago and were certified in anesthesia approximately 6 to 10 years ago, 84 % were still in practice in Canada at the beginning of the year 2000. For the most recent batch of certificants, the retention rate is worse. It appears that only 76% of the most recent certificants, those who were certified between 1995 and 1998/99 are in practice in Canada. Ideally, we should see retention rates in excess of 90% for certificants of 6-10 years back and retention rates in excess of

95% for the most recent certificants. Looking at the year by year figures, not shown in the calculations above, the turning point seems to have been with the medical graduates of 1989 who would have completed training in 1993. The retention rates are particularly low for certificants of the years 1993, 1995 and 1996. These years coincide with the physician brain drain years, so perhaps we are observing the impact of a higher than usual level of emigration of anesthetists in the latter part of the decade of the nineties.

Table 25 also provides data on the proportion of men and women in each year's cohort of new certificants. The % of women has certainly increased, but not as much as one might have expected. For certificants from 1970-1975, 16% were women. For certificants from 1976-1980, 22% of certificants were women. The figure increased to 26% for the certificants of 1981-1985 but dropped back to 23% for the certificants o 1986-1990, and 24% for those of 1991-1995. It is only in the last 5 years that women have constituted 31% of the certificants in anesthesia. At this rate, it will take another 15 or more years before women reach 30% of the anesthetists in practice.

- **Where does this leave us?**

The data related to RCPSC certification brings to a close the second part of this report that attempts to illustrate with data some of the elements that form part of the planning model. It has pointed out the availability or lack of data in many areas relevant to workforce planning. In particular, this exercise has shown weaknesses in the flow data related to flows of physicians into and out of practice. Where does all this leave us with respect to what is perhaps, the single most important question of all, how many anesthetists should we be educating each year? Can we, with the material presented so far, draw some tentative conclusions about how many new entrants there should be each year into the specialty of anesthesia?

- **How many anesthetists should we educate each year?**

At the time of writing this report, the acute problems in meeting day-to-day service requirements in anesthesia have led to an easing of the restrictions and regulations on the recognition of the qualifications of anesthetists from outside Canada. In the last couple of years (and much longer in some provinces), the Colleges of Physicians have been fast –tracking the entry of anesthetists into Canada. Innovative schemes for testing clinical competence are in the pipeline and will soon make it easier to deal with immediate shortages of anesthetists. Because it takes so long to educate a new batch of specialists, during periods of scarcity, there is no alternative in the short run, to importing physicians from abroad. We should be under no illusion, however, that the need to have recourse to these solutions is a sign of failure in assuring an adequate physician supply. It is precisely the type of situation that workforce planning is supposed to prevent. A workforce plan should lead to smooth and orderly changes over time in physician supply. What we see now is one of those periodic sharp swings in the need to increase physician supply rapidly, brought about by blinkered decisions taken years earlier based on faulty analysis of workforce issues.

A workforce plan has little bearing on immediate supply problems, which can only be dealt with in an ad hoc fashion as is being done now. For the future, it is important that, in general, the medical education system be geared to educating enough physicians to meet Canada's healthcare needs, and that includes enough anesthetists. How many should this be?

Thinking in terms of cohorts of entrants and leavers, and using some of the statistics found in this report, a quick analysis produces the following results:

Target number of anesthetists in the year 2016: 3100 (based on requirement for 3300 anesthetists; 200 FTEs to be supplied by family physicians).
Starting with current complement of 2200 anesthetists:
If all anesthetists aged 65+ retire by the year 2016: 1100 retirements;
Currently practising anesthetists, still in practice in 2016: (2200 – 1100) = 1100
New entrants required by the year 2016: (3100 – 1100) = 2000
Average annual entrants required = 2000 ÷ 16 = 125 per year
If 90% of qualifying anesthetists practise for at least 10 years : (125 ÷ .90) =139
If 95% of entrants to training programmes complete anesthesia: (139 ÷ .95) = 146

The numbers above suggest that, given future requirements, the age composition of the current anesthesia workforce, retention and completion rates in training and practice, that around 145 anesthetists need to enter practice each year from 2001 to 2016. Even if 15% of these new entrants come from abroad, Canada's training system would need to turn out about 125 certificants each year. This is very much higher than the numbers currently emerging from training, something like a 50% increase. It is impossible for numbers in training to increase immediately to accommodate such a large increase, and in any case, even if intakes were increased substantially, it would take at least 5 years before output increased also.

There are 2 important consequences arising out of this: 1) Canada will be importing anesthetists for quite a few years to come,
2) The workforce problems of anesthesia cannot be solved in isolation from the workforce problems of all other types of physicians. Current medical school enrolment is too low. It is in the process of being increased on a more or less ad hoc basis. If a carefully crafted workforce planning model were in use, a more rational basis for deciding upon both the number and location of medical school places would be available. Press reports talk of medical school capacity of 2000 places, compared with the 1500 or so current slots. It will be quite a number of years before the expansion of capacity is completed and, unfortunately, the goal of 2000 places is almost certainly too low. If the specialty of anesthesia is not

atypical, a target of a minimum of 2200 places and, perhaps, as many as 2500 places is required. The specialty of anesthesia is far more likely to be able to secure the number of recruits it needs from a medical school graduating class that started out with 2500 persons than it is from a graduating class based on a 2000 student or 2200 student intake.

Thus, this report must end where it started: anesthesia is part of a system. Its problems cannot be solved in isolation. This attempt to design a model for workforce planning in anesthesia and to apply and test some parts of it with data could be an example for other specialties and for family medicine.

Conclusions

This section will be brief. Many conclusions have been drawn in the various sections of this report, and they will not be repeated here.

The principal conclusion that does need to be stressed is that it is feasible to conduct specialty specific workforce planning. Methods to do so have been described and illustrated. A theoretical model has been proposed for the specialty of anesthesia. It has emphasized the need to find an improved, credible method of estimating future requirements.

The proposed method was tested by making demand projections for each of the provinces based on future population projections for the year 2016. In order to demonstrate the potential of the model, projections were also made for 1999. What is reported is strictly the numbers that came out of the model. Persons familiar with the situation in each province can judge for themselves whether the projections seem credible. If they are, we have a tool we can work with. If not, we may have to find out what went wrong and go back to the drawing board.

Many problems with data were identified. These problems included a total absence of many relevant flow statistics and in cases where data series do exist, several whose quality needs improvement. Concern with data quality and involvement with the improvement of data are long term concerns. Indeed, operating and implementing a physician workforce planning model requires a long-term commitment, with dedicated resources and qualified personnel. This kind of work is usually done in either a university or governmental setting.

The use of billings data to study in depth, the fields of activity and the utilization of specific types of health care services is promising. It is an area of research that should be continued.

This study has demonstrated very starkly that the analysis of utilization of health care services must transcend the simple, uncorrected use of population/physician ratios as indicators of physician supply.

There appear to be sizeable shortages of anesthetists in most Canadian provinces at this time. Unfortunately, there is no way to rapidly increase the output of Canadian anesthesia training programmes. Canada's medical schools are not graduating enough doctors to feed larger numbers into the Post-M.D. training system and it will be quite a while before the size of the graduating class increases sufficiently to expand the numbers qualifying as anesthetists. This means that Canada will be importing anesthetists from abroad for some time to come. Successful recruitment from abroad should not substitute for the need to concurrently deal with the fundamental problem, which is insufficient output from Canada's own educational programmes.

The special contribution made by family physicians in the provision of anesthesia services needs to be documented in a systematic fashion. In particular, it is necessary to compute the share of services delivered by family physicians in each province. Is there a way to reach agreements about the share of anesthesia services that will be delivered by family physicians? Should training opportunities be provided in a more formal manner? At present, family physicians can have a few months of tailor-made training. There are no statistical records of the numbers taking advantage of such training opportunities. Because as much as 20% of a province's anesthesia services may be delivered by family physicians, there is a real risk that growing shortages of family physicians will impact on the ability or willingness of family physicians to deliver anesthesia services. If family physicians reduce their level of activity in anesthesia, this will have to be made up by increasing the numbers of specialist anesthetists.

The methods proposed for studying the demand and supply of anesthesia services can be an example to other specialties of how they can examine the factors specific to changes in requirements for the particular set of health care services delivered by each specialty