Canadian Hospital Costs and Productivity

L. Auer

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Preface

This study provides a new and comprehensive view of the changes in the Canadian hospital sector since its services came to be insured under the Hospital Insurance and Diagnostic Services Act of 1957. The purpose of the Act was to ensure Canadians access to hospital services regardless of age, state of health, or income. Over the years the coverage has been extended to medical and other health services and is now administered under the National Health Act. That system of health care is widely regarded in international circles as being a success because it provides comprehensive care at reasonable cost. The system is very popular with the public because it protects citizens from the financial shock of unexpected hospitalization, from the threat of chronic illness without care, and from the depletion of financial resources in old age.

One of the outstanding features of the health care system has been the persistent rise in the cost of hospital care, which accounts for some 40 per cent of the total cost of health care in the country. Hospitals are administered by provincial governments on the basis of global budgeting principles. The federal government provides substantial support through transfers of funds under the Established Programs Financing (EPF) Act. During 1986, the federal government introduced amendments to the EPF which could, by the year 1990, withdraw $2 billion of support from this program. The provinces therefore face pressures from two directions. On the financing side, they are being forced to absorb a larger proportion of the cost of hospital financing. On the expenditure side, they are experiencing a steady increase in costs of delivering care. This study suggests that the pressures of constraint will intensify in the years ahead.

The main thrust of this study is to measure costs and productivity in the hospital sector at a detailed level, to examine the changes that have occurred over the years, to explore the provincial variations, and to isolate some of the major factors that impact on costs and productivity in hospital care.

The result of this analytical work is to provide some ominous early warnings of the pressures on cost that will arise in the future. The study therefore points quite forcefully to the need to examine alternate modes of delivery of hospital care as we search for a more cost-effective system.

The study was done by Ludwig Auer, a senior economist on the staff of the Economic Council of Canada. His work is based on hospital data provided by Statistics Canada and Health and Welfare Canada, and traces the changes in cost and volume of services to over 20 individual hospital units, and to inpatient and outpatient services. Dr. Auer has also made a painstaking effort to experiment with various approaches to the measurement of output and productivity. This is an area of great concern to economists generally because of the growing importance of the service sector in the economy.

Readers of this study will find here a useful road map of the measurement problems in hospital services, a valuable and clear description of the forces that have led to the

increase in the cost of hospital care since the 1960s. As a result, it is essential reading for those who wish to engage in dialogue about the ways in which Canada could constructively deal with the pressures on cost, while still maintaining the unique quality of service and access which Canada has managed to develop since the implementation of national health insurance.

Judith Maxwell
Chairman

Summary

Canada's health care system provides ready access to high-quality care for all Canadians. By international standards it provides comprehensive care at reasonable cost. Yet the cost of health care has risen over the years, and Canada, like many other industrialized countries, has difficulty keeping health care costs from rising still further.

Over the past two decades hospital expenditures expanded at an average annual rate of 15 per cent (Table 3-1). They accounted for a full 40 per cent of the rise in total health costs and contributed more to it than any other institution.

This study shows how much of the rise in hospital expenditures has been attributable to population growth; how much, to higher wages and prices; and how much, to more-intensive hospital care. It also shows what has happened to hospital productivity over the years and how costs and productivity have varied among the provinces.

– Canada's population increased from 18 million in 1960 to 24 million in 1980. As Canada's birth rate declined, the proportion comprising the youngest age groups diminished; and as life expectancy improved, the proportion of the elderly expanded. Canada's population aged.

– About one-tenth of the rise in hospital costs – 1.5 percentage points of the 15 per cent growth – was attributable to these population changes, practically all of which resulted from population growth. The changes in age structure had a very small impact on hospital admission rates, because the lower admission rates of younger women, associated with the sharp reduction in birth rates, more than compensated for the greater numbers of elderly patients (see Table 3-2).

Nearly nine-tenths of the rise in hospital costs resulted not from hospital admissions but from the higher cost per admission (Table 3-3).

– Higher wage rates accounted for a major portion of the higher costs (Table 3-4). Wage settlements in hospitals exceeded those in the rest of the economy but followed essentially the same cyclical pattern. Wage pressures developed with the higher growth rates of the 1960s, the stimulative monetary policies of the 1970s, and the oil price shocks of the mid- and late 1970s. Also, the higher educational attainment of nurses and improved employment opportunities had an impact on hospital wages, although not nearly as much as did other economywide factors.

– Net of inflation, hospital services increased at an average annual rate of 5 per cent, or roughly three times as fast as one would have expected on the basis of Canada's annual population growth of 1.5 per cent. Taking into account the fact that the population is getting older and that elderly people, once admitted to hospital, do not recuperate as quickly, perhaps that is what should have been expected.

– Indeed, since the early 1960s the share of hospital beds dedicated to elderly patients has increased from approximately 30 per cent to 50 per cent. Hospitals managed to cope

with this age-conditioned demand for services by reducing the length of stay of younger patients (Table 3-8).

– But as hospitals shortened the stay, they intensified their service. In the diagnostic and therapeutic department, for example, the number of radiological examinations and treatments increased from 1.33 units per case in the early 1960s to 1.44 units in the late 1970s. This sort of change made for greater case intensity (Table 3-6).

– At the same time, nursing hours per patient-day increased from about 3 to over 5; nursing hours per surgical procedure, from 9 to 11; and nursing hours per delivery in the obstetrical suite, from 11 to 21. This made for greater task intensity (Table 3-9).

The very large increase in obstetrical nursing hours was associated with the greater number of babies delivered by caesarean section. The rate of caesarean births increased from 5 per cent of all hospital births in 1970 to more than 15 per cent in 1980-81 (Chart 4-3). This trend has become a matter of concern; but, as yet, no consensus on the optimal rate for caesareans has emerged.

– As in other industries, the estimation of hospital productivity hinges on a comparison of output with resource inputs: the greater the output in response to additional resource inputs, the better the productivity performance. Ideally, hospital output should be evaluated on the basis of improvement in the health status of hospital patients. Since that was not possible, substitute measures of health status were used, such as life expectancy and health expectancy. These were found to be neither sufficiently refined nor sensitive enough to capture quantitatively the response to variations in hospital services over the years or among provinces. Hospital output was approximated, therefore, by the volume of hospital services, measured by the number of hospital patients and adjusted for surgical day-care visits and other outpatient services.

– Hospital output, so measured, increased in two decades from 2.7 million inpatient equivalents in 1961 to 4.0 million in 1979-80, or by approximately 40 per cent. Over the same period, Canada's population grew from 18.2 to 23.9 million, or by about 30 per cent. While the population grew at a fairly steady rate, the volume of hospital patients expanded rapidly during the 1960s and then slowed down during the 1970s (Chart 3-4).

– Hospital resources – i.e., the inputs of labour, capital, fuel, and materials – increased at an average annual rate of 5.3 per cent and more than doubled over the same period (Table 3-5). Labour inputs, for example, increased from 320 to 656 million hours; capital stock, from $2.2 billion to $4.8 billion.

– Based on the growth rate of 3.0 per cent per year for the volume of patients and 5.3 per cent for hospital resources, hospital productivity declined over those years at an annual rate of 2.3 per cent (Table 3-11).

– Historically, new industrial technology brought improvements in productivity. The same applied to medical technology. The antibiotics of the 1940s and 1950s reduced infectious disease and shortened hospital stays. But during the 1960s and 1970s new and very costly treatments appeared – renal dialysis, kidney transplants, open-heart surgery – and, with them, more-intensive care. It involved more of everything: more

laboratory tests and examinations; more equipment; more space; and, most of all, more nursing time.

– It was impossible to determine whether all the additional hospital services of those two decades yielded commensurate benefits; it was possible, however, to show how much of the change in hospital productivity could be attributed to greater service intensity. We found that hospital productivity (as defined here) improved if, and only if, all of the greater service intensity, be it per hospital case or per hospital task, yielded commensurate benefits to patients. If, however, the benefits were not quite as great and amounted to less than two-thirds of the growth in service intensity, hospital productivity declined (Table 3-11).

– Provincially the growth of hospital expenditures per patient varied from 10 to 15 per cent per year. Task intensity varied from a low of 1.7 per cent per year in Ontario to a high of 5.3 per cent in Newfoundland. These variations had little to do with the aging of the population. They stemmed from other factors that often ran counter to the demographic trends (Table 3-7).

– The levels of hospital operating expenditures varied among the provinces by as much as 40 per cent (Table 4-1). Provincial variations in hospital admission rates were a major factor. They ranged from 25 per cent below the national average in Quebec to 25 per cent above average in Saskatchewan. Even after full allowance for the needs of different age groups, most of the provincial variations remained (Table 4-2).

– Generally speaking, lower rates reduced the costs per hospital patient in the Atlantic provinces and in the Prairie provinces; higher wage rates added to the costs in Quebec, Ontario, and British Columbia. In most provinces wage rates reinforced the provincial cost variations.

– Service intensity contributed more than wage rates to the provincial variations in costs per patient. Its contribution to costs ranged from -35 percentage points for Prince Edward Island to +25 percentage points for Quebec (Table 4-2).

– The levels of task intensity varied by 20 per cent, and most of the variation was attributable to differences in labour intensity. In the Atlantic provinces and the Prairie region, labour intensity increased relative to the Canadian average over the years; in the province of Quebec it diminished.

– The provincial levels of hospital productivity – measured by the number of hospital patients per personnel-year (with full allowance for outpatient visits to the surgical suite and an allowance for diagnostic, therapeutic, and other outpatient services) – varied from a low of 12 patients per personnel-year in Quebec to a high of 21 in Prince Edward Island. When allowance was made for service intensity, essentially the opposite pattern of variations emerged. Quebec's hospital productivity was low when measured by number of patients and high when based on volume of service (Table 4-11).

– Hospital resources contributed very little to provincial variations in hospital output per worker – mainly because resources per worker were not very large. In recent years capital stock per hospital worker, for example, varied among the provinces by as much as 60 per cent, but it averaged less than $20,000 per worker and was only about one-third of that in the rest of the economy.

– The empirical evidence of this analysis leads to the conclusion that the greater service intensity in hospital treatment, aside from economywide wage and price inflation, contributed in a major way to the rise in hospital expenditures. When the various cost factors were split into two groups, the *economywide factors* – e.g., population growth and general inflation – accounted for 8 percentage points of the 15 per cent growth in costs; the *hospital-specific factors* – e.g., admissions per capita, service intensity, and hospital-specific inflation – accounted for the other 7 percentage points (Table 5-1).

– This leads to the conclusion that the productivity of hospitals has not improved over the years regardless of whether hospital output was measured by the number of hospital patients or the case volume of hospital services; in both cases it has declined. If hospital costs are to be contained in future, the productivity of hospitals needs to be improved by providing incentives for greater efficiency.

– Attempts are being made, especially in the United States, to change the system. In both Canada and the United States, the health insurance system has paid the costs whatever they might have been: the higher the cost, the more the system paid. Although global budgeting and government-imposed restraints have kept outlays in Canada from rising as fast as in the United States, neither the Canadian nor the U.S. reimbursement corrected for the wrong incentive signals.

– New patient-oriented accounting systems and payment schedules based on Diagnosis-Related Groups (DRGs) are currently being introduced in the United States and seriously being considered in some parts of Canada. Based on 467 DRGs and the average treatment costs for each – e.g., a hip joint replacement at $5,000 – hospitals would be paid that amount. If the actual cost were less, the hospital could keep the difference; if it were more, it would have a loss.

– Other patient-oriented accounting systems are not based on reimbursement for hospital treatment but on the annual prepayment of health care costs per year. It is aimed at keeping the cost per member of the group down. The simplest and most common of the prepaid health care systems are the Health Care Maintenance Organizations (HMOs); others include the Preferred Provider Organizations (PPOs in the United States), Community Health Centres (CHCs in Canada), and prepaid services provided by hospital chains to group members.

– It is concluded, furthermore, that there is an urgent need for cost/benefit evaluation of surgical interventions and alternative hospital treatments. Although conceptually the procedural steps of cost/benefit analysis are well established, the inherent complexities and uncertainties make it impossible to weigh all the conceivable consequences. Simplistic as it may seem, initially the potential benefit of hospital treatment could be quantified by the potential years of human life gained. Subsequently, other decision criteria could be added.

– And it is concluded that new labour-saving technology needs to be developed. Judging by trends in hospital equipment prices and wage rates, investment in labour-saving technology should have been advantageous for most of the past two decades and well into the future. Yet very little funding has been directed at the development and adoption of new labour-saving technology for institutional care. The process could be accelerated if funds were made available by government and private enterprise for development and/or the adoption of new labour-saving technology and if incentive payments were made to hospitals for experimental trial runs.

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READER'S NOTE

The reader should note that various conventional symbols similar to those used by Statistics Canada have been used in the tables throughout this text:

- - amount too small to be expressed
- . . figures not available
- . . . figures not appropriate or not applicable
- – nil or zero
- p preliminary figures.

Details may not add up to totals because of rounding.

1 Some Fundamental Health Care Issues

As consumers of health services and caring members of society, we want the best health care possible. We know that we are aging and that our health care needs intensify as we get older. But as taxpayers we also know that our resources are limited and that we must be realistic.

At a time of slow economic growth and rising government deficits, there is a persistent concern about the difficulties of maintaining and improving health care in the future. Much of it is focused on the greater health care needs of an aging population. Questions are also raised about the allocation of resources among health care institutions and the capacity of the system to keep pace with advances in medical technology. And more generally, it is recognized that clearer guidelines are needed by which to evaluate current health care expenditures and to decide now how much to spend on health care in the future.

Productivity, measured in terms of output per unit of resource input, is an important factor in allocating resources and controlling costs. The ultimate output of a health care system is the well-being of the population. Measurement of well-being, and of the aspects of health care that contribute to it, would be an impossible task. But without objective measures, there is a tendency to look at health care simply in terms of providing more and better services. That can lead to underfunding, overcrowding, delays, inequities, and rapidly escalating costs.

Health Care Issues in Industrialized Countries

The central objective of Canada's universal health insurance system is to provide access to equitable, high quality health care for all Canadians, regardless of their income or province of residence. It is generally agreed that this objective is being met. Looking at progress since 1960, the system has become well established throughout the provinces and is popular with the public. By international standards, it provides comprehensive care at reasonable cost. However, Canada and other industrial countries throughout the world have similar problems in controlling costs and ensuring the efficiency of national health care systems.

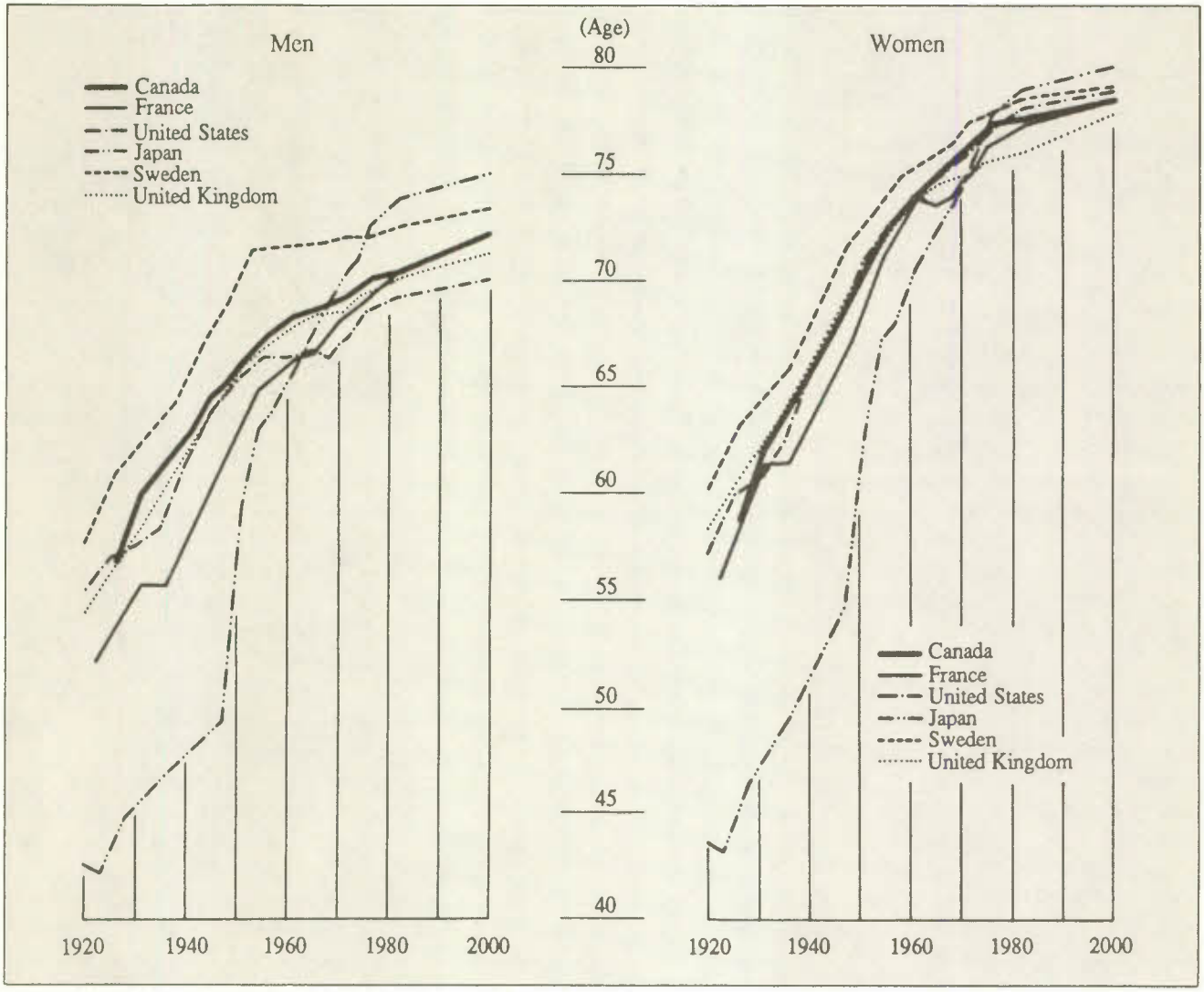
Countries that already enjoy a high standard of health care face the problem of diminishing returns for additional health care investment. Life expectancy, one of the major indicators of health status, does not increase at the same rate as improvements in health services. International trends in life expectancy have gradually levelled off and appear to be converging toward 72 years for men and 78 years for women by the year 2000 (Chart 1-1). In Canada, life expectancy increased by roughly six years from 1940 to 1960 and by three years from 1960 to 1980. A rise of about 1.5 years is projected for 1980 to 2000.[1] While improvements in life expectancy have diminished over the years, resources devoted to health care have increased. For example, the number of active civilian physicians per 100,000 population in Canada expanded by about 25 per cent from 1940 to 1960 and by 50 per cent in the next two decades. If present recruitment rates continue, it could grow by 100 per cent by the year 2000.[2]

International variations in health among industrial countries bear little relationship to variations in health care expenditures per capita, type of financing, or intensity of service. Admittedly, international cost comparisons bristle with problems of exchange rate adjustment, variations in age structure of the population, incidence of morbidity, range and quality of services, accessibility, financing and overhead costs. But expenditure gaps among countries are too large to be ignored. In a comparison of six industrial countries, Japan has the second lowest health care expenditures and the fewest doctors per capita, but a higher life expectancy and lower infant mortality rate than the United States, which has the highest health care expenditures per capita (Table 1-1). Canada spends less per capita on health care than the United States, while the number of doctors per capita, life expectancy, and infant mortality are nearly the same.

Health expenditures in industrial countries have been rising rapidly and have taken a growing share of national income. On average for 12 countries, health care expenditures grew almost twice as fast as gross domestic product from 1960 to 1980. In Canada, health care expenditures have risen from $2.1 billion in 1960 to $22 billion in 1980. Until the 1980s their rate of growth in relation to GNP was slower in Canada than in most industrial countries – one and one-half times as fast from

Chart 1-1

Life Expectancy at Birth, Selected Industrial Countries, 1920-2000



SOURCE World Health Organization, *World Health Statistics* (Geneva: WHO, 1983).

1960 to 1970 (from 5.6 per cent of GNP in 1960 to 7.1 per cent in 1970) and about the same as GNP growth throughout the 1970s (between 7.0 to 7.5 per cent throughout the decade). It then increased to 7.7 per cent of GNP in 1981, and to 8.5 per cent in 1982.[3]

Governments in industrial countries have been assuming a growing share of health care costs. For the same 12 countries, the share of costs provided by governments increased from about 60 per cent in 1960 to nearly 80 per cent in 1980.[4] In Canada, government support increased from roughly 40 per cent in 1960 to 75 per cent in 1980. This support has meant better access and greater equitability. But as health care is a very large item of social expenditure in government budgets, it comes under particular scrutiny at times of slower economic growth. A consensus has emerged among industrial countries that health care costs must be brought under tighter control.

Countries have taken different approaches to the problem of rising costs. When Britain established the first comprehensive national health service, the government promised unlimited free medical care of the highest possible standard to all citizens. As expenditures soared, the supply of services was rationed by longer waiting queues rather than higher prices or taxes. Now, it seems likely that people will be encouraged to supplement public health insurance by additional private insurance.

Table 1-1

Resource and Health Indicator Estimates, Selected Countries, 1984

	Health expenditures per capita	Number of doctors per 100,000 population	Life expectancy at birth	Infant mortality per 1,000 live births	Deaths from heart disease per 100,000 population
Canada	1,074	192	74	10	326
United States	1,500	192	73	12	435
West Germany	900	222	73	13	584
France	800	172	74	10	380
Japan	500	128	76	7	266
Britain	400	154	73	12	579

SOURCE Except for Canada these estimates, which are not strictly comparable, were adopted from a Health Survey by *The Economist*, April 28, 1984, p. 19, Table 1. The estimates in columns 3 and 5 were modified according to WHO statistics published in 1983. The Canadian estimates were derived from Health and Welfare Canada, *National Health Expenditures in Canada, 1970-1982* (Ottawa: HWC, 1984), pp. 34 and 39.

At the same time, a combination of private and public health insurance and fee-for-service payments has contributed to the rapid rise in health care costs in the United States. To control this rise, the United States is now implementing a strict system of controls on prices of nearly every hospital treatment. Control systems of this sort, in turn, are thought to have led to some of the distortions in health care delivery and to higher treatment costs in France and West Germany.[5]

Every approach to controlling costs of a national health system has its problems and limitations. All are subject to the criticism that health – and the value of health services that contribute to it – cannot be measured in dollars alone.[6]

Concerns in Canada

The Royal Commission on Health Care Services issued a report in 1964 in which it stressed the enormous gap between scientific knowledge and skills on the one hand and the accessibility of health services on the other. The Commission recommended that Canada take the legislative, organizational and financial decisions necessary to close this gap and make health services available to all residents without hindrance of any kind [Canada, 1964].

The Hall Commission reported in 1980 on the extent to which the principal goals of Canada's health insurance program had been met.[7] The issue which dominated the Commission hearings was the growing practice of extra-billing and the conflict between the medical profession and the provinces over physicians' fee schedules. The Commission recommended that "the provinces ensure reasonable compensation to physicians and, should an impasse occur or negotiations fail, rely on a mechanism of binding arbitration by an independently chaired board" [Hall Commission, 1980, pp. 28-29].

The Commission addressed the issues of federal-provincial health care funding, national standards, hospitals, preventive health care, nursing care, and other health care professions and services. It advocated an expansion of existing services. To meet the problem of additional costs in the have-not provinces, it proposed that the federal government share costs for provinces wishing to institute additional insured services. It similarly proposed that closer provincial alignment to national standards be achieved through federally provided matching grants in specified program areas. The problem of cost containment was recognized but not examined.

The Commission's examination of hospital services relied heavily on a study issued by Statistics Canada [Lefebvre et al., 1978] which projected a very moderate rate of growth in hospital service requirements. This study based its projections on past utilization rates, demographic projections, and the potential for the transfer to lower-cost nursing homes and home care programs of elderly hospital patients requiring chronic and convalescent care. It concluded that existing facilities would be sufficient to meet service requirements up to the mid-1990s if such alternative care programs were made available. After that, it projected growth beyond existing facilities which would accelerate after the year 2000. Expenditures (in constant 1976 dollars) were projected to rise from $5.4 billion in 1981 to over $11 billion in 2031, due partly to general population growth but even more to aging of the population as members of the baby-boom generation enter the years of more intensive health care needs.

Actual increases in hospital care costs have been well above these projections. And since publication of the Hall Report, the need for cost containment has been increasingly apparent. The slowdown in economic growth and rising government deficits have made expansion in health care expenditures a matter of growing concern. Provincial governments are concerned that their tax revenues, together with federal transfers, may not be sufficient to cover health care costs. The federal government is concerned that cuts in provincial funding and opting out by physicians will limit access to health care facilities and medical services. The medical profession is concerned that funding for hospitals is inadequate for today's case load, that fees for services will stay too low, and that incomes of medical practitioners will not keep up with those of other professions. And the general public is concerned that the quality of Canadian health care is at stake.

Scope of this Study

The problems summarized above are apparent in looking at hospital services and the rise in hospital costs. This study examines the sources of rising costs and the links between costs and productivity in hospital services from 1960 to 1980. The analysis is confined to public, general and allied special hospitals. It does not cover mental institutions, homes of special care, private hospitals, and federal institutions but includes over 90 per cent of all hospital beds in Canada.

Hospital care is the largest single item of health care. A wide spectrum of data is available. Financial statistics can be examined by hospital department, task and type of service. The analysis presented here shows how much hospital costs have risen since 1960 and relates the rise in costs to changes in wages and prices, in the volume of hospital services, and in the intensity of hospital care. This analysis provides some global measures of hospital productivity that derive from individual hospital departments and service units. The study also examines the ways hospital costs and service volumes vary by province and the possible underlying causes of these variations. The findings lead to conclusions about the potential for improvements and greater cost effectiveness of hospital services.

This study does not deal with all the major determinants of hospital use, cost, and productivity. It is well known that many of the diseases of an affluent society arise from sedentary work, lack of exercise, smoking, drinking, environmental pollution, social stress, and accidents. There is also some evidence that physicians as producers of medical care can affect the volume, productivity, and cost-effectiveness of hospital services. These issues are beyond the scope of this analysis. The study also does not quantify the advantages and disadvantages of different methods of accounting or budget control, such as per diem versus per patient, morbidity or treatment-oriented accounting. Nor does it deal with alternative, and possibly less costly, modes of health care delivery for the elderly and the chronically ill. Instead, it concentrates on the utilization of hospital services, their costs, and the potential savings that could be derived from more efficient delivery of such services.

The conceptual approach is outlined in Chapter 2. The growth of hospital costs, in Canada and the provinces, is related to the volume of hospital services, labour input, intensity of service, and productivity in Chapter 3. Levels of provincial hospital costs are related to their underlying causes in Chapter 4. Finally, the potential for cost savings and productivity improvement are explored in Chapter 5.

2 Concepts and Methodology

Institutional care, which includes care in hospitals and homes of special care, absorbs the largest proportion of health expenditures. That proportion has expanded gradually from 45 per cent in the early 1960s to 55 per cent since in the mid-1970s (Table 2-1). Operating expenditures of "public, general and allied special hospitals" alone increased from $0.6 billion in 1960 to $12 billion in 1982/83, and have contributed more to the rise in total health care costs than any other single item (Chart 2-1).[1]

This chapter outlines the concepts and methods used in this study to analyse the underlying causes of the increase in hospital costs, the changes in hospital output, and the implications for hospital productivity and cost effectiveness. Throughout this study, hospitals refer specifically to public, general and allied special hospitals. The methodology is described here in general terms; a more detailed description is provided in a technical appendix available separately.

Analysis of Hospital Costs

There are two basic approaches to measuring hospital costs. Population-based measures relate costs to the total population served by the hospital system. They include such indicators as the number of hospital beds per 1,000 population, hospital days per capita, and hospital costs per capita. Utilization-based measures relate costs to actual use of services and facilities. They include, for example, hospital costs per patient stay, payroll expenses per patient-day, admission rates per hospital bed, and hospital capacity utilization. Although we touch on "population-based" indicators in this study, our emphasis is on "utilization-based" indicators. Cost per hospital stay is related to wage rates, prices, and service intensity of each of the major hospital departments. This approach enables us to trace the rise in hospital costs to individual hospital departments and services provided by each.

Table 2-1

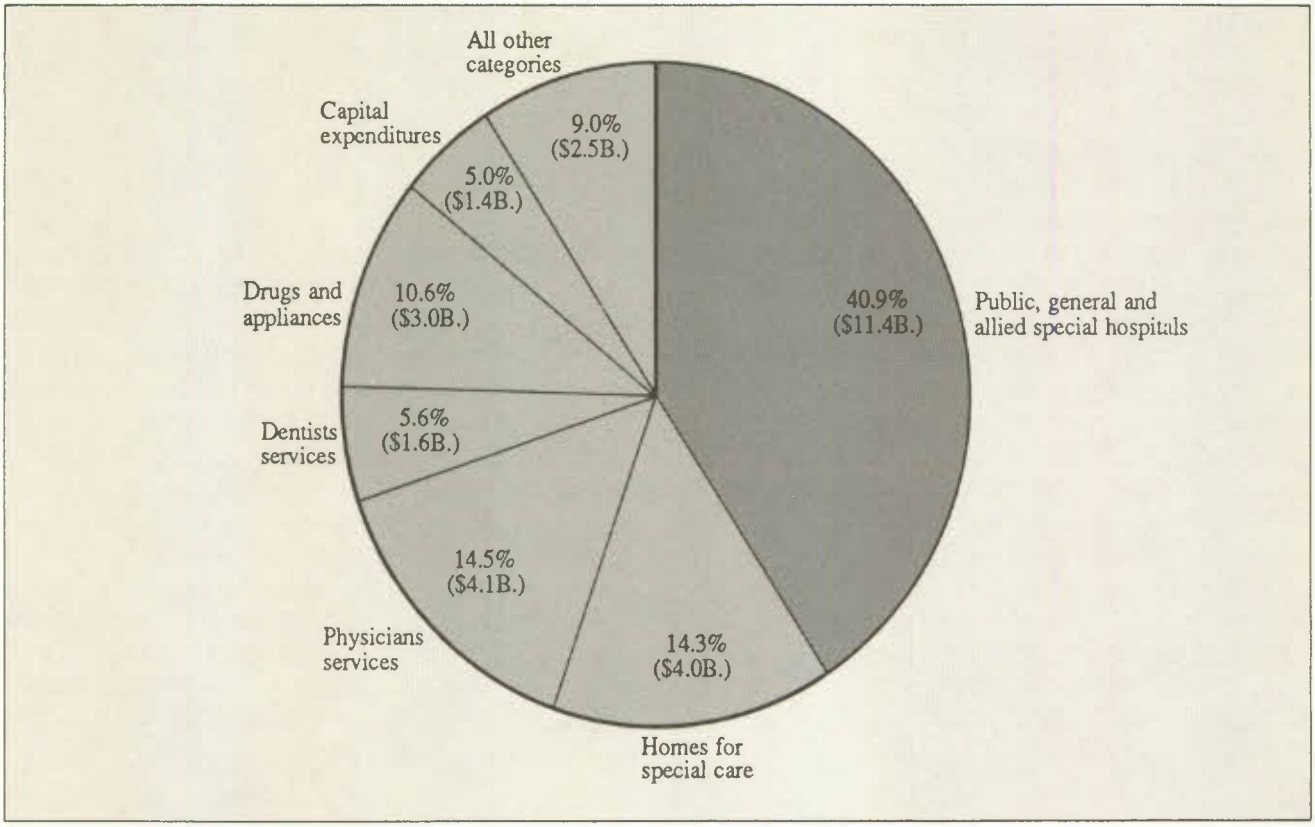
Health Expenditures by Major Category, Canada, 1960-80

	Category				
	Institutional care	Professional services	Drugs and appliances	Other expenditures	Total
			(Million dollars)		
1960	946	513	310	385	2,154
1965	1,604	770	455	533	3,363
1970	3,263	1,410	779	803	6,255
1975	6,940	2,692	1,299	1,450	12,381
1980	12,195	4,903	2,266	2,815	22,179
1981p	14,255	5,613	2,684	3,217	25,769
1982p	16,588	6,564	3,275	3,661	30,088
			(Per cent)		
1960	44	24	14	18	100
1965	47	23	14	16	100
1970	52	23	12	13	100
1975	56	22	10	12	100
1980	55	22	10	13	100
1981	55	22	10	13	100
1982	55	22	11	12	100

SOURCE Based on *National Health Expenditures in Canada, 1960-75* and *1970-82*. Department of Health and Welfare Canada, Information Dissemination Unit, Ottawa, Tables 3a and 2, 1960-65 and 1970-80, respectively.

Chart 2-1

Increase in Health Expenditures by Category, Canada, 1960-82*



* The increase for each category is expressed as a percentage of the total increase and in billions of dollars.

SOURCE Department of Health and Welfare. *National Health Expenditures in Canada, 1970-1982* (Ottawa: 1984), p.13.

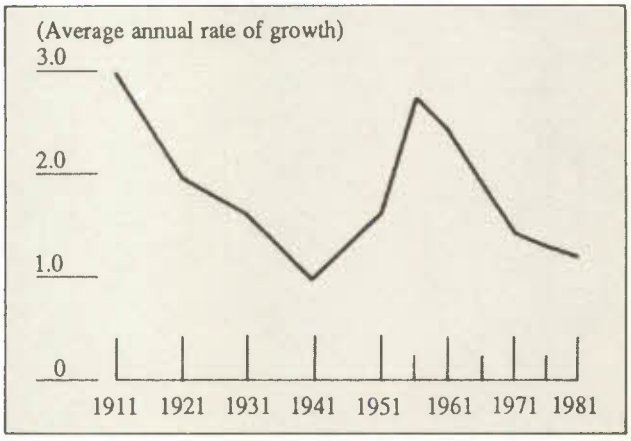
Population-Based Indicators

Population changes can affect hospital costs in two ways. An increase in the population served by the hospital system can be expected to cause a proportionate increase in total hospital costs. If the age structure of the population also changes, then per capita hospital costs will be affected as well, because hospital utilization rates vary with age.[2]

Between 1960 and 1980, Canada's population increased from roughly 18 million to 24 million. The annual rate of population growth, which reached a high of 2.8 per cent in the early 1950s due to the postwar baby boom and high immigration, declined sharply thereafter, falling to 1.5 per cent by 1971 and 1.1 per cent by 1981 (Chart 2-2).

Chart 2-2

Rates of Population Growth, Canada, 1911-81



SOURCE Statistics Canada, *Canada's Population Demographic Perspectives*, 1976 Census of Canada Series, Cat. No. 98-802E (Ottawa: September 1979).

Three major changes are apparent in comparing the structure of Canada's population in 1961 and 1981: a decreasing proportion of children, an increasing proportion of young adults, and an increasing proportion of elderly persons (Chart 2-3).

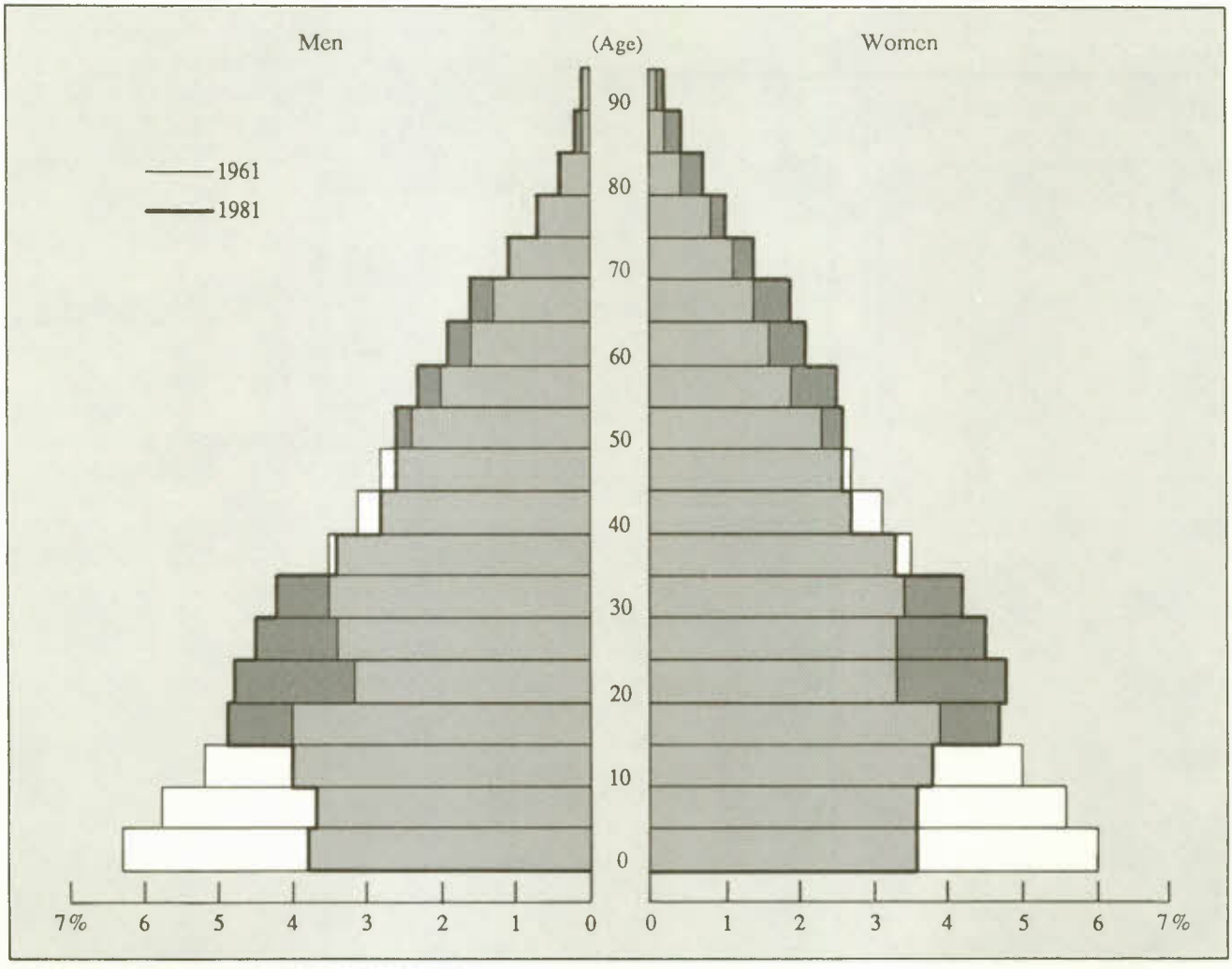
The increase in young adults reflects the entry into adulthood of the baby-boom generation in the late 1960s and early 1970s. Had birth rates remained unchanged, this increase would have been accompanied by a rise in the proportion of children. Instead, birth rates dropped so sharply that the proportion of the population age four years and under fell from 8.4 per cent in 1971 to 7.3 per cent in 1981 [Statistics Canada, 1982].

In the past, immigration has had a considerable impact on age structure, as Canada has received large inflows, particularly of young adults and families with small children. In recent years, immigration has declined substantially and its impact on the overall age structure of the population has therefore been negligible.

Finally, the extension of life expectancy over the past half century has raised the proportion of elderly Canadians reaching age 65 and over. Their share of the population increased from 5.6 per cent in 1931 to 9.7 per cent in 1981, mainly as a result of these gains in longevity [Statistics Canada, 1984].

Chart 2-3

Age Distribution of Canada's Population, 1961 and 1981



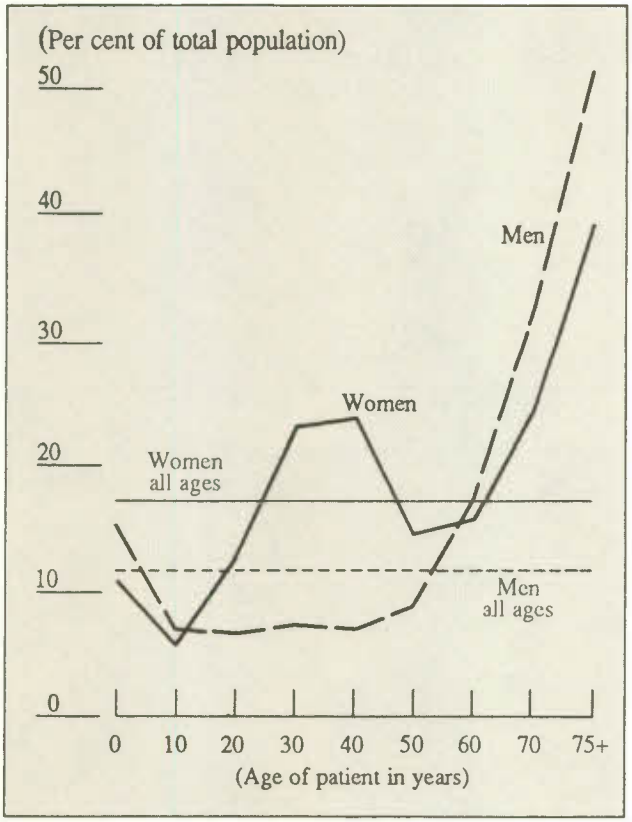
SOURCE Demographic Division, Statistics Canada, 1985.

As people age they use health care services more frequently, including hospital services. Hospital admission rates by age, showing the proportion of each age group admitted to hospital annually, provide one measure of age-specific utilization (Chart 2-4). In 1980/81, admission rates for men varied from 7 per cent for age 25-35 to over 50 per cent for over age 75. The decline in birth rates meant that the per cent of admissions for women in the childbearing years was well below that in 1961 (per capita admission rates of women, age 20-44, for example, dropped from 29 per cent in 1961 to 20 per cent in 1980/81, or roughly by one-third). As with men, admission rates of women increased sharply beyond age 60.

Smaller shares of the younger population groups and larger shares of the older groups made for more frequent hospital stays, while lower birth rates made for less frequent stays. The estimated net effect of these changes depends on both, the population shifts and the hospital admission rates of individual age groups.[3]

Chart 2-4

Hospital Admission Rates for Men and Women, Canada, 1980/81



SOURCE Statistics Canada, *Hospital Morbidity*, Cat. No. 82-206 (Ottawa: 1984), p. 39.

Earlier work by the Economic Council [Boulet and Grenier, 1978] suggested that the health expenditures associated with an aging population would not require a greater share of Canada's GNP. This conclusion was based on the assumption of no change in age-specific utilization, continued growth of the economy, and rising government revenues. Denton and Spencer, in a 1980 study based on the same assumptions, projected that health care costs would not exceed 8 per cent of GNP before the year 2000.

In fact, however, health expenditures exceeded 8 per cent of GNP by the early 1980s, some 15 to 20 years ahead of schedule. During the early 1980s Canada went through a deep economic recession. As health expenditures did not decline with GNP, they of course absorbed a somewhat larger share. But neither the slump in economic growth nor the long-term shift in the age structure of the population explains why health expenditures increased so rapidly over the years. The major factor that the projections did not allow for was that as the proportion of elderly persons increased, the health care system responded to their needs by providing new and more intensive health care services.[4] It appears that utilization-based factors must have had a far greater impact on costs than changes in population size or age structure would imply, a proposition that will be examined later.

Utilization-Based Indicators

Changes in hospital utilization are reflected in changes in the cost of hospital labour and supplies, and changes in the intensity of hospital services.

In this study we measure hospital costs per patient, relating costs to the five major hospital departments:

Nursing services;
Administrative and supportive services;
Diagnostic and therapeutic services;
Supplies and drugs; and
Education.

Each of the five major departments has a number of units that provide different services. Our statistical analysis differentiates between the 23 different service units listed below, and covers all of them as far as data permit:

Nursing services
- Inpatient care
- Surgical suite
- Nursing administration
- Nursery

Central supply
Obstetrical suite
Emergency

Administrative and supportive services
General administration
Dietetics
Plant operation
Housekeeping
Laundry
Medical records
Linen

Diagnostic and therapeutic services
Laboratory
Radiology
Pharmacy
Rehabilitation
Social work

Supplies and drugs
Medical and surgical supplies
Drugs

Education
Medical staff
Technicians and other.

Within this organizational structure, annual changes in hospital operating costs and provincial differences in levels of cost can be traced to each of the major hospital departments and each of the service units within departments.[5]

To estimate how much of the rise in hospital operating costs came from wage and price increases and how much from more intensive services, annual hospital statistics for 1961 to 1979/80 were assembled on a consistent and comparable basis for inpatients and outpatients, both nationally and by province. The data were obtained from financial summaries prepared by the hospitals in every province for tabulation by Statistics Canada. Although the data were screened carefully and certain adjustments were made when necessary, the final data base was not entirely free from problems of data comparability over the years and among provinces. It is believed, however, that analysis of this data base can give an indication of the major sources of the rise in hospital operating expenditures and their national and provincial variations.[6]

Changes in Wages and Prices

Estimates of wage rates were derived from the financial statistics of the various hospital departments. In the nursing department, for example, hourly wage rates of nurses attending to the emergency suite increased from an estimated $1.38 in 1961 to $9.40 in 1979/80. In the surgical and obstetrical suites they increased at very similar rates. In acute inpatient care, in the nursery, and in central supply, wages started out from lower levels and remained at lower levels; in nursing administration they started from, and remained at, higher levels. In hospital administration, maintenance, and other supportive services, wage rates ranged from between $1.01 and $1.73 in 1961 to between $6.25 and $8.71 in 1979/80, with wages of service personnel for dietetics, linen supplies, laundry, and housekeeping at the lower end of the range and wages for plant operations and general hospital administration at the upper end. In diagnostic and therapeutic services, wage rates among the five service units increased from between $1.07 and $2.50 in 1961 to between $9.27 and $10.42 in 1979/80. The largest increases occurred in the education department, with wage rates of the staff training nurses and laboratory technicians at the lower end of the range and those of the medical training staff at the upper end (Table 2-2).

Price indexes were similarly applied to supplies of the various hospital departments and services. Unlike wage rates, however, they could not be derived from hospital statistics and were based, therefore, on various expenditure components of the consumer price index: medical supplies and pharmaceuticals; food purchased from restaurants; laundry sent out; sheets and pillow cases; disposable diapers; water, fuel, and electricity; and several others.

The impact of changes in wage rates and prices on total hospital operating expenditures depends primarily on two factors: the magnitude of wage and price changes in each department unit, and the unit's share of total operating costs (Table 2-3).

Service Intensity

Service intensity, in the context of this study, refers to the net effect of all changes in the complexity of hospital services on the volume of inputs used. Many factors, including technological advances, service delivery innovations, changes in health needs and in the age structure of the population, have an impact on the intensity of services. In particular, new medical technology has permitted new and more specialized services. Not only has new technology been applied to old diseases, but new diagnostic equipment has made diagnosis and treatment more specialized and more service-intensive. Some new surgical procedures, such as open-heart surgery and hip

Table 2-2

Wage Rates and Price Indexes of Various Hospital Services, Canada, 1961 and 1979/80

	Hourly wage rates		Price indexes[1]	
	1961	1979/80	1961	1979/80
	(Dollars)		(Per cent)	
Nursing services				
Inpatient care	1.18	8.61	37	283
Surgical suite	1.36	9.40	103	150
Nursing administration	2.11	12.32	89	194
Nursery	1.22	9.00	83	217
Central supply	1.17	6.75	37	283
Obstetrical suite	1.30	9.42	103	150
Emergency	1.38	9.40	103	150
Administrative and supportive services				
General administration	1.73	8.71	89	194
Dietetics	1.08	6.57	75	234
Plant operation	1.73	8.43	74	230
Housekeeping	1.01	6.16	56	226
Laundry	1.08	6.25	75	238
Medical records	1.41	7.02	89	194
Linen	1.02	6.30	87	168
Diagnostic and therapeutic services				
Laboratory	2.00	10.42	103	150
Radiology	2.50	12.62	103	150
Pharmacy	1.85	10.00	89	194
Rehabilitation	1.86	9.27	103	150
Social work	1.07	9.54	96	172
Supplies and drugs				
Medical and surgical supplies	..	..	103	150
Drugs	..	..	103	150
Education				
Medical staff	1.57	21.46	96	172
Technicians and other	1.06	5.90	96	172

1 Price indexes for materials and supplies of the 23 hospital services are based on 10 consumer price indexes (1971 = 100).
SOURCE Estimates based on data from Statistics Canada.

joint replacement, have added to the complexity of hospital services while others, such as appendectomies, have become routine. At the same time, hospitals have made adjustments in service delivery. They have shortened hospital stays and switched from inpatient to outpatient services. All of these changes are reflected in two indicators: case intensity and task intensity.

Case Intensity

Case intensity measures the real dollar value of labour and supplies per hospital patient (Table 2-4). The units by which it is measured are defined for each service of the various hospital departments. For example, "patient-days" is the unit for nursing administration and for inpatient care; "newborn patient-days" is the unit for the nursery; "mothers delivered" for the obstetrical suite; and services per patient, such as radiology examinations, laboratory tests or therapeutic treatments, for the diagnostic and therapeutic services department. Each unit is weighted by its cost in the base year.

This indicator allows meaningful comparison of changes in cost and volume of services per patient in various hospital departments over time.[7] For example, deliveries in the obstetrical suite declined from 16 per cent of hospital admissions in 1961 to 10 per cent in 1979/80, while emergency cases increased from 5 to 10 per cent of admissions.

Table 2-3

Hospital Services as a Proportion of Total Hospital Operating Costs, Canada, 1961 and 1979/80

Total hospital operating costs = 100.0

	Proportion of total costs			
	Wage costs		Non-wage costs[1]	
	1961	1979/80	1961	1979/80
	(Per cent)			
Nursing services				
Inpatient care	21.8	31.9	0.2	0.3
Surgical suite	2.7	2.8	--	--
Nursing administration	1.6	2.2	--	--
Nursery	1.7	1.6	--	--
Central supply	1.2	1.0	--	--
Obstetrical suite	1.1	1.1	--	--
Emergency	0.1	0.1	--	--
Administrative and supportive services				
General administration	6.5	7.6	4.4	3.0
Dietetics	6.8	5.9	7.9	3.7
Plant operation	3.9	3.1	4.8	5.3
Housekeeping	5.0	4.7	0.7	0.7
Laundry	2.1	1.3	0.5	0.5
Medical records	1.0	1.5	0.1	0.1
Linen	0.5	0.2	0.7	0.3
Diagnostic and therapeutic services				
Laboratory	3.7	4.3	1.1	1.4
Radiology	2.2	1.5	1.0	0.3
Pharmacy	0.8	1.3	--	0.1
Rehabilitation	0.5	1.3	--	0.1
Social work	0.2	0.9	0.2	0.2
Supplies and drugs				
Medical and surgical supplies	..	..	3.7	3.7
Drugs	..	..	5.0	2.7
Education				
Medical staff	1.6	1.9	--	0.1
Technicians and other	3.5	0.2	0.4	0.1
Total	68.8	76.4	31.2	23.6

1 Totals do not add because of rounding. Double dashes signify less than 0.1 per cent.
SOURCE Based on data from Statistics Canada.

Since case intensity is lower for emergency cases than for obstetrical cases, on average, this change made for lower case intensity and lower overall hospital costs.

Task Intensity

Task intensity measures the labour and supplies that are used per hospital task (Table 2-5). The units by which it is measured are the hours of labour and quantity of medical and surgical supplies used for a particular hospital task. For example, a delivery in the obstetrical suite required 11.3 hours of nursing staff in 1961 and 21.0 hours in 1979/80, an increase in task intensity from 60 to 112 per cent of the 1971 base-year value of 18.7 hours. Other elements of task intensity include the nursing hours required for inpatient care per hospital-day, per radiological

Table 2-4

Estimated Case Intensity of Various Hospital Services for Inpatients, Canada, 1961 and 1979/80

	Case intensity of labour services[1]		Number of service units per admission [2]	
	1961	1979/80	1961	1979/80
	(1971 dollars)		(Units)	
Nursing services				
Inpatient care	171.36	198.31	10.80	12.25
Surgical suite	16.81	17.73	0.43	0.45
Nursing administration	9.92	16.08	53.58	86.88
Nursery	15.94	9.12	1.02	0.58
Central supply	6.76	7.66	10.80	12.25
Obstetrical suite	10.79	6.84	0.16	0.10
Emergency	0.45	0.90	0.05	0.10
Administrative and supportive services				
General administration	36.79	43.30	10.80	12.25
Dietetics	38.17	38.99	18.20	18.28
Plant operation	19.65	23.46	0.04	0.04
Housekeeping	26.23	31.13	0.04	0.04
Laundry	8.64	8.83	117.96	115.31
Medical records	3.97	18.70	44.79	222.80
Linen	2.46	2.93	10.80	12.25
Diagnostic and therapeutic services				
Laboratory	17.91	28.98	228.64	368.95
Radiology	6.81	7.85	1.17	1.46
Pharmacy	4.10	4.81	10.80	12.25
Rehabilitation	3.20	6.34	1.06	2.22
Social work	3.58	4.27	10.80	12.29
Supplies and drugs				
Medical and surgical supplies	. . .	. . .	10.80	12.25
Drugs	. . .	. . .	10.80	12.25
Education				
Medical staff	16.29	18.85	10.80	12.25
Technicians and other	11.33	12.32	10.80	12.25

1 For explanation see text.

2 The definition of service units varies: In the case of inpatient care, for example, the service units are "patient-days"; for the nursery, they are "newborn patient-days," and for the obstetrical suite, they are "mothers delivered."

SOURCE Estimates based on data from Statistics Canada.

examination, per laboratory test, and per therapeutic treatment. To obtain a measure of change, the total annual change in task intensity of each department service is evaluated at the 1971 wage rate per nursing hour and the 1971 dollar value of medical and surgical supplies (Table 2-5).

Adjusting for Outpatient Services

Costs of hospital outpatient services have expanded from less than 5 per cent of total hospital operating expenditures in 1961 to more than 10 per cent in 1979/80. In tracing the sources of rising expenditures, we follow the format of Statistics Canada and distinguish between outpatient services provided by the organized outpatient department and those provided by the emergency unit, radiology, laboratory, day surgery, and rehabilitation. The cost of each of these services is again related to the number of hours of attending nursing personnel, the hourly wage rates, medical and surgical supplies, and prices. Once again, a distinction is drawn between task intensity and case intensity. As well, the various cost items are standardized in terms of cost per outpatient visit.[8]

Table 2-5

The Task Intensity of Various Hospital Services for Inpatients, Canada, 1961 and 1979/80

	Task intensity of labour services[1]		Hours per unit of service[2]	
	1961	1979/80	1961	1979/80
Nursing services				
Inpatient care	0.24	0.34	3.75	5.47
Surgical suite	0.26	0.30	10.15	11.75
Nursing administration	0.17	0.20	0.03	0.04
Nursery	0.20	0.35	3.06	5.46
Central supply	0.32	0.36	0.20	0.23
Obstetrical suite	0.17	0.31	11.25	20.97
Emergency	0.44	0.25	3.71	2.15
Administrative and supportive services				
General administration	0.23	0.36	0.77	1.28
Dietetics	0.36	0.42	0.76	0.89
Plant operation	0.25	0.29	150.57	152.80
Housekeeping	0.41	0.44	286.98	308.90
Laundry	0.50	0.44	0.04	0.03
Medical records	0.40	0.21	0.04	0.02
Linen	0.46	0.23	0.10	0.05
Diagnostic and therapeutic services				
Laboratory	0.22	0.26	0.02	0.02
Radiology	0.28	0.24	1.64	1.45
Pharmacy	0.22	0.47	0.08	0.19
Rehabilitation	0.19	0.41	0.58	1.11
Social work	0.14	0.38	0.05	0.13
Supplies and drugs				
Medical and surgical supplies	...	...	...	...
Drugs	...	...	...	...
Education				
Medical staff	0.13	0.09	0.20	0.13
Technicians and other	0.64	0.06	0.67	0.06

1 For explanation see text.
2 Totals do not add because of rounding.
SOURCE Estimates based on data from Statistics Canada.

Analysis of Hospital Output

No existing measure of health services generally or hospital services in particular is comprehensive enough to cover all the dimensions of health and health improvement they produce. The World Health Organization (1975) defines health itself in comprehensive terms as "a state of complete physical, mental, and social well-being and not just the absence of disease and infirmity." However, it does not translate that concept into empirical analytical methods that could be applied to hospital services.

Putting dollar values on the production or welfare gains an individual or society receives from hospital services is not yet possible. Under a "production accounting" approach, the dollar value of longer survival or improved health would vary with the individual's productivity and income. As incomes vary among individuals and regions, and as they rise and fall with changes in the economy, the dollar values derived from hospital services would similarly fluctuate. Under a "welfare accounting" approach, dollar costs would also have to be assigned to pain, debility and family burden arising from sickness. If either of these approaches were used to compare services provided

to individuals in different regions, they would reflect not only variations in health status but also regional differences in productivity and per capita incomes. Moreover, even if values could be estimated with precision for individuals, they would not be additive. The sum of individual gains would not match the total gain to a society.[9] For all these reasons, the output of health services is measured by selected health indicators that are proxies for more comprehensive measures.

Life Expectancy

Life expectancy is considered one of the most reliable indicators of health status presently available. However, all the major industrial countries, including Canada, seem to have reached the point at which further improvements in health services have little or no measurable impact on the average life span of the population. In Canada, as in other countries, faster expansion of health services since the early decades of this century has been accompanied by slower gains in life expectancy (Table 2-6).

The minor variations in life expectancy among industrial countries seem to be more closely related to differences in lifestyle and environmental conditions than to variations in health care.[10] The same is true of variations among provinces. Since the 1930s or 1940s, Saskatchewan, Alberta and British Columbia have had the highest life expectancy in Canada and Quebec the lowest, although the differences have narrowed somewhat over the years. These provincial variations are very small (Table 2-7) and they are not associated with variations in health services (Table 2-8). For example, health expenditures per capita are below the Canadian average in Newfoundland and Saskatchewan, while life expectancy is above average.

The view expressed in the mainstream of the literature on health economics – that further substantial expansion of existing health services in countries such as Canada would not lead to a corresponding extension of life expectancy – is supported by these data. That conclusion, of course, should not be interpreted as reason to oppose additional expenditures or services. Some expansion in health services, such as organ transplants or treatment of premature infants, could well be justified on humanitarian grounds. In addition, many health services are directed not only at survival but at improving the quality of life. It is not yet known, however, how much of the increase in hospital costs since 1960 translates into longer life and how much into making life more livable, especially for the elderly.

Health Expectancy

A new and promising indicator of health status is the "health expectancy index." This is a more comprehensive measure than life expectancy or infant mortality, as it takes into account not only the prospective length of life but also the degree of activity restriction. Estimates derived from the Canada Health Survey of 1978 [Statistics Canada, 1981], show that the quality-adjusted life expectancy (essentially years of life free from major disability) was 68.7 years and that life expectancy free from activity restrictions was 61.0 years (Table 2-7). These adjusted life

Table 2-6

Changes in Life Expectancy and Selected Health Resources, Canada, 1931-76

	Life expectancy at birth		Active civilian physicians[1]	Registered nurses	Rated hospital-bed capacity[2]
	Male	Female			
	(Years)			(Per 100,000 population)	
1931	60	62	97	..	395 *
1941	63	66	93	242	463
1951	66	72	102	314	510
1961	68	74	117	430	551
1971	69	76	152	671	641
1976	70	77	174	775	719

* Capacity for 1932 instead.

1 Including interns and resident physicians.

2 With respect to public, general and allied special hospitals only.

SOURCE Based on data from Statistics Canada, the Royal Commission on Health Services, and Health and Welfare Canada.

Table 2-7

Regional Variation in Health and Life Expectancy, Canada, by Region, 1978/79

	Health expectancy of		
	Disability-free life	Quality-adjusted life	Life expectancy
		(Years)	
Atlantic region	59.2	67.8	74.4
Quebec	61.8	68.5	73.6
Ontario	61.6	69.1	74.8
Prairie region	61.2	69.2	75.2
British Columbia	58.6	68.2	75.2
Canada	61.0	68.7	74.6
		(Per cent)	
Atlantic region	97	99	100
Quebec	101	100	99
Ontario	101	100	100
Prairie region	100	101	101
British Columbia	96	99	101
Canada	100	100	100

SOURCE Russ Wilkins and Owen Adams, *Healthfulness of Life: A Unified View of Mortality, Institutionalization and Non-Institutionalized Disability in Canada, 1978*. The Institute for Research on Public Policy, Montreal, 1983, Table 7.2, p. 124.

expectancy estimates for activity restrictions were found to vary between men and women, among various income groups, by size of community, and by province and region. Unfortunately, as yet such estimates of quality-adjusted life expectancy in Canada are available for only a single year and are not sufficiently refined to show with precision the impact of hospital and other health services.

Patient Volume

In view of the vague and uncertain relationship between health expenditures and life or health expectancy, hospital output is not measured in this study in terms of its impact on the health of the population as a whole but rather in terms of the services provided to hospital patients. Several measures were applied (Table 2-9). As a first approximation we used the number of hospital inpatients as a proxy for hospital output, on the assumption that hospital output varies directly with the number of hospital inpatients. As a second approximation, we adjusted for outpatient services by converting the annual outpatient visits into inpatient equivalents on the basis of dollar cost per visit and cost per inpatient hospital stay, and adding this to the number of inpatients. As a third approximation, we combined inpatients and day-surgery patients. And as a fourth, we also made allowance for other outpatient services, again converting them on the basis of annual dollar costs. Each of these measures of hospital output adds additional credits for outpatient services. Since outpatient services have increased faster than inpatient services, each successive approximation yielded a higher rate of growth of hospital output.

In addition to these indicators of hospital output, changes in the age and morbidity patterns of hospital patients were estimated. With Canada's population aging, it was important to capture changes not only in the number of elderly people admitted to hospitals, but also in the length of their hospital stay relative to younger patients.[11] In addition, we found it useful to adjust for morbidity treatment. The adjustments for morbidity treatment were based on the relative cost estimates of 46 DRGs, ranging from 0.24 for treatment of pregnancy complications to 2.24 for heart attacks (see DRG Nos. 13 and 33 of Table 2-10).

Successive approximations of the utilization-based measures of output should tell us how sensitive our measures of hospital output are to definitional changes and whether the more refined measures are better (and if so, how much) in explaining the impact of increases and provincial variations in hospital costs on the productivity of hospital services.

Analysis of Hospital Productivity

Five major factors are known to affect output and productivity performance in goods-producing industries: capital, labour, energy, materials, and technological change. Studies of industrial productivity performance have shown that these five factors account for the growth of industrial output. We include the same factors here.

Output per Worker

As a first step, productivity can be measured by the ratio of patients to staff. The higher the ratio, the higher the productivity. This is a measure of output per unit of labour input and is comparable to the conventional measure of labour productivity in other industries.

It is then useful to examine the relationship between labour productivity and the quantities of other factors – material, capital and energy – per worker, and to determine how much of the variation in factor productivity came from variations in case intensity and task intensity.

Factor Inputs per Worker

From other industry studies it is known that labour productivity is not so much a matter of work effort and

Table 2-8

Regional Variation in Health Expenditures and Institutional Expenditures Per Capita, Canada, by Province, 1979

	Total health expenditures	Institutional expenditures		
		Total	Homes for special care	Hospitals
	(Dollars per capita)			
Canada	802	443	96	347
Newfoundland	703	400	81	319
Prince Edward Island	713	368	109	259
Nova Scotia	868	448	99	349
New Brunswick	672	397	91	306
Quebec	788	490	90	400
Ontario	821	436	118	318
Manitoba	801	419	145	274
Saskatchewan	737	404	120	284
Alberta	823	423	119	304
British Columbia	854	398	109	289
	(Per cent)			
Canada	100	100	100	100
Newfoundland	88	90	84	92
Prince Edward Island	89	83	114	75
Nova Scotia	108	101	103	101
New Brunswick	84	90	95	88
Quebec	98	111	94	115
Ontario	102	98	123	92
Manitoba	100	95	151	79
Saskatchewan	92	91	125	82
Alberta	103	95	124	88
British Columbia	106	90	114	83

SOURCE Health and Welfare Canada, *National Health Expenditures in Canada, 1970-1982*, Department of Health and Welfare, mimeographed, Tables 4 and 31-40.

Table 2-9

Estimated Growth Rate of Hospital Output, by Various Measures, Canada, by Province, 1961-79/80

	Inpatients	Inpatients + outpatient equivalents	Inpatients + day surgery	Inpatients + day surgery + other visits
		(Per cent)		
Canada	1.6	2.1	2.7	3.0
Newfoundland	3.5	3.9	5.4	5.5
Prince Edward Island	2.7	3.0	3.4	3.5
Nova Scotia	1.8	2.3	2.8	3.2
New Brunswick	0.9	1.4	1.9	2.3
Quebec	1.1	1.7	2.4	2.8
Ontario	2.1	2.5	3.1	3.4
Manitoba	0.2	0.7	1.5	1.8
Saskatchewan	0.3	0.6	0.6	0.8
Alberta	2.2	2.6	3.1	3.4
British Columbia	2.4	2.7	3.1	3.3

SOURCE Based on data from Statistics Canada.

Table 2-10

Hospital Cost Ratios of Diagnosis-Related Groups, Based on United States Data

Diagnosis-Related Groups (DRGs)	(H-ICDA code range)[1]	Relative cost per hospital stay
1 Infective	(001-136)	0.77
2 Malignant neoplasm	(140-209)	1.94
3 Other neoplasms	(210-239)	0.83
4 Diabetes mellitus	(250)	1.12
5 Other endocrine	(240-246; 251-258)	1.07
6 Nutritional metabolic	(260-279)	1.68
7 Hematologia	(280-289)	1.36
8 Mental	(290-319)	0.86
9 Other nervous system	(320-358)	1.15
10 Eye	(360-378)	0.70
11 Ear	(380-389)	0.58
12 Hypertension	(400-405)	1.03
13 Acute myocardial infarction	(410)	2.24
14 Other heart	(390-398; 411-429)	1.66
15 Cerebrovascular	(430-438)	1.95
16 Other vascular	(440-458)	1.32
17 Acute URI	(460-465)	0.54
18 Pneumonia	(480-486)	1.09
19 Bronchitis, emphysema, asthma	(489-493)	0.87
20 Hypertrophy of tonsils and adenoids	(500)	0.32
21 Other respiratory	(470; 494-496; 501-519)	1.13
22 Dental	(520-526)	0.62
23 Peptic ulcer	(531-534)	1.23
24 Other upper	(527-530; 535-537)	0.82
25 Appendix	(540-543)	0.91
26 Hernia	(550-553)	0.77
27 Biliary tract disease	(574-576)	1.18
28 Other GI	(560-573; 577)	0.95
29 Urinary	(580-599)	0.93
30 Male genital	(600-607)	0.90
31 Breast	(610-611)	0.47
32 Female genital	(612-629)	0.71
33 Complications of pregnancy	(631-639)	0.24
34 Abortion	(640-646)	0.49
35 Normal delivery	(650)	0.88
36 Complicated delivery	(651-664)	1.00
37 Complications of puerperium	(670-678)	0.43
38 Skin	(680-709)	0.97
39 Musculoskeletal	(710-739)	0.99
40 Congenital anomaly	(740-759)	0.80
41 Diseases of infancy	(760-768)	2.21
42 Symptoms and ill-defined conditions	(770-796)	0.76
43 Fracture	(800-829)	1.36
44 Other trauma	(830-959)	0.99
45 Adverse effects	(960-999)	0.84
46 Special conditions	(y00-y19; y50-y86)	0.56
Total		N.A.

1 H-ICDA coding ranges refer to the Hospital Adaptation of the International Classification of Disease..

SOURCE J. D. Rustuccia and D. V. Murphy, "Estimating hospital costs by diagnosis group," in the *Inquiry* 17:155-164 (Summer 1980), p. 158.

skill as of capital, material, and energy inputs per worker. It is almost taken for granted that workers employed in modern plants equipped with labour-saving machinery can produce more per hour than those employed in older and poorly organized plants with less efficient machinery. Not only can they produce more, but they can do it with less effort. Similarly, if more materials and supplies are purchased rather than produced from scratch, workers can produce more with less effort. And if more energy is consumed because more machinery and equipment are used, workers can accomplish their task more effectively. This argument seems plausible on the surface. If it were true, the policy implications for improving labour productivity would be clear: simply increase efficiency by updating hospitals and equipment; purchase more materials, supplies, and services; and provide additional funds to those regions that lag behind so they can invest more in new hospitals.

In a primarily market-based economic system as exists in Canada, price and productivity tend to serve as relevant indicators for the efficient allocation of resources. Assuming that resource use in Canada and the provinces tends towards efficiency – where the productivity gain from additional factor inputs just matches the extra costs – we can estimate the contribution of capital, material and energy inputs to annual changes or interregional variations in industrial output per worker. Adding the further assumption that in a competitive market environment the use of hospital resources is conditioned by the same criteria of efficiency, we can also approximate the contribution of capital, material, and energy inputs to interprovincial variations in hospital output per worker.

Technology

Studies of industrial productivity have also shown that new technology, as it affects the productivity of capital, labour, energy and material inputs, is the crucial factor of the five, and also the most difficult to evaluate quantitatively in terms of its elements and their effects on industrial performance. It is quite possible, however, to derive global estimates of the impact of technology on output and productivity.

Production Function Analysis

Economists use various estimation techniques to determine the underlying sources of productivity changes. One of these is production function analysis.[12] This technique can be used to determine how much of an improvement in productivity has come from changes in the quantity of the various factors of production and how much from changes in "factor productivity" such as advances in technology, education of the labour force, quality of management and labour, and other institutional factors.

By applying the same estimation technique to the hospital sector under essentially the same assumptions, the impact of the major resource inputs on hospital output can be estimated. Their contribution to change is the combination of their growth rates and their shares in overall hospital costs.

In accounting for growth, annual changes and provincial variations in hospital output are attributed to the resource factors and the productivity of these factors. The magnitude of this so-called "factor productivity" is measured by the difference between the growth rate of hospital output and the contribution to growth of the major resource factors.[13]

Although it is widely accepted that productivity in the service sector has improved more slowly than in the goods-producing sector, the lack of improvement is often attributed to poor measures of output. As suggested earlier, we shall apply some more refined measures of output to see if and how that might affect our results. First, however, we examine the actual hospital costs.

3 The Growth of Hospital Costs

In this chapter we examine the rise in hospital costs in Canada and in each province from 1961 to 1979/80. We first look at the increase in terms of population-based indicators to see how much of the rise has been due to population growth and aging of the population. We look next at the increase in terms of utilization-based measures, to see how much has been due to higher wages and prices and how much to greater service intensity. We then examine the ways that service intensity and hospital productivity are linked.

All of the key elements of hospital costs described in the previous chapter have a bearing on the persistent rise in hospital costs, but some elements are more important than others. While no estimation techniques exist that would tell exactly how important each one is, some first approximations can be made (Table 3-1).

The Impact of Population-Based Factors

Population growth adds to economic growth but can also add to the burden of social overhead. Over the past two decades Canada's population grew at an average annual rate of 1.5 per cent – a higher rate than that of most other industrial countries. Population growth varied among the provinces according to historic patterns of migration flows and natural growth. British Columbia has had consistent net immigration gains since as far back as 1871. Alberta had very high gains in the early decades of this century, net losses during the Depression, and high rates again after the Second World War. By contrast, Quebec has had persistently low net migration rates, especially between 1871 and 1901, and high birth rates from the turn of the century until the early

Table 3-1

Impact of Various Cost Elements on the Growth of Hospital Operating Expenditures, Canada, by Province, 1961-79/80

	Canada	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
						(Per cent)					
Total operating expenditures, of which	14.9	17.6	13.7	14.5	13.4	17.0	13.7	13.0	12.6	15.8	15.7
Population growth	1.6	1.3	0.9	0.8	0.9	1.1	1.9	0.6	0.2	2.7	2.8
Other factors[1]	0.6	0.5	0.4	0.7	0.7	0.8	0.6	0.7	0.3	0.6	0.5
Per capita expenditures, of which	12.7	15.8	12.4	13.0	11.8	15.1	11.2	11.7	12.1	12.5	12.4
Aging of population[2]	0.3	0.3	0.2	0.2	0.3	0.4	0.3	0.2	0.2	0.1	0.2
Age-specific factors[3]	-0.6	1.8	1.6	0.6	-0.3	-1.2	-0.5	-0.8	0.0	-0.4	0.6
Other factors[4]	0.4	0.5	0.2	0.2	0.0	0.7	0.5	0.1	-0.1	-0.1	-1.1
Cost per hospital patient,[5] of which	12.6	13.2	10.4	12.0	11.8	15.2	10.9	12.2	12.0	12.9	12.7
Wage rates	8.2	6.9	7.4	7.9	7.9	8.7	8.3	8.2	7.7	8.4	8.4
Prices	1.1	1.7	1.4	1.5	1.3	0.8	1.0	1.1	1.2	1.2	0.9
Service intensity[6]	3.3	4.6	1.6	2.6	2.6	5.7	1.6	2.9	3.1	3.3	3.3

1 Included under this heading are the cost effects of outpatient expenditures, as well as part of the interaction terms of population growth and per capita expenditures.
2 Based on column 3 of Table 3-2 and Appendix Table C-24, column 4.
3 Based on column 6 of Table 3-2 and Appendix Table C-24, column 7.
4 Other factors represent mainly interaction terms of admission rates per capita and cost per admission.
5 Based on Appendix Tables C-1 to C-11.
6 Based on Appendix Tables C-12 to C-22.

SOURCE Estimates based on data from Statistics Canada. Data in this and subsequent tables on hospital operating expenditures refer to public, general and allied special hospitals and tuberculosis sanatoria only; they exclude mental hospitals and homes for special care.

1960s and a sharp decline thereafter. The Maritimes have sustained migration losses for many years.[1]

Over the past two decades population growth accounted for as much as one-sixth of the rise of hospital expenditures in British Columbia, Alberta and Ontario, and less than one-tenth of the rise in all other provinces. Nationally, it added 1.6 percentage points to the annual growth in hospital operating expenditures and accounted for a little over one-tenth of the 14.9 per cent rise in costs. Most of the increase did not come from population growth but from growth in per capita hospital expenditures (Table 3-1).

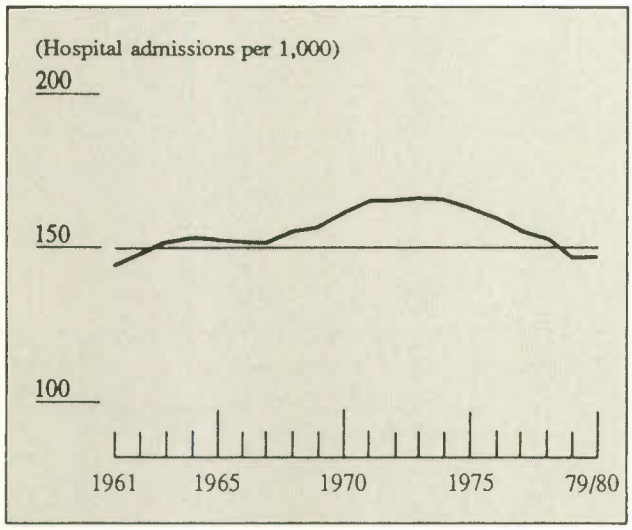
Per capita hospital expenditures can be attributed to two factors: hospital admission rates and cost per admission. A change in either will lead to a proportionate change in per capita expenditures.[2] Hospital admission rates today are at about the same level as two decades ago. They have varied over the years from a low of 146 hospital admissions per 1,000 population in 1961 to a peak of 165 in the early 1970s and then down to 148 in 1979/80 (Chart 3-1).

Some of this variation in hospital admission rates can be traced to the aging of the population. The net effect of entry of the baby-boom generation into the age 20-44 group was negligible. Men in this age group have below-average hospital admission rates while women have above-average rates because of childbirth and related complications. Two trends that added to the overall admission rate were the decline in the proportion of children, the age group with the lowest hospitalization rates, and the rise in the proportion of the population age 65 and over, the age group with the highest hospitalization rates. The dramatic decline in birth rates over the past two decades and the corresponding decline in hospitalization rates of young women, however, more than offset these effects (Table 3-2).

Altogether, the aging of Canada's population, the decline in the birth rate, and the longer life expectancy of the elderly had very little impact on hospital admission rates, as they cancelled each other out over the past two decades. Essentially the same applied to all provinces. Most of the growth in per capita hospital expenditures did not come from higher hospital admission rates but from higher costs per admission. It is therefore necessary to look at utilization-based factors to determine why the cost per hospital admission (or per patient) increased so much.

Chart 3-1

Changes in Inpatient Admission Rates, Canada, 1961-79/80



NOTE Data for public, general and allied special hospitals.
SOURCE Based on data from Statistics Canada.

The Impact of Utilization-Based Factors

Cost per hospital patient in Canada increased over the past two decades at an average annual rate of 12.6 per cent. This estimate is based on wage, price and cost developments of the 23 inpatient service units within the five major hospital departments. Almost half of the cost rise is attributable to the nursing department; somewhat over one-third to administrative and supportive services; about one-tenth to diagnostic and therapeutic services; and the small remainder to medical supplies, drugs, and education (Table 3-3).

There is widespread belief that nursing care accounts for the largest share of hospital operating expenditures and contributes most to the rise in hospital costs. It is noteworthy, and perhaps surprising, to find that administrative and supportive (i.e., central administration, dietetics, plant operation, housekeeping, laundry, medical records, and linen) contributed as much to the rise in hospital operating expenditures as all inpatient care by the nursing department.

Provincially, the average annual rise in cost per hospital patient ranged from a low of 10.4 per cent per year in Prince Edward Island to a high of 15.2 per cent in Quebec. Most of the other provinces came close to the national average. Patterns of expenditure growth by department were fairly uniform throughout Canada. In

Table 3-2

Impact of Aging of the Population and Other Age-Specific Factors on the Hospital Admission Rates of Inpatients, Canada, by Province, 1961-80

	Contribution					
	Aging population			Age-specific factors		
	Smaller share of youngsters (0-19)	Larger share of elderly (65+)	Change in hospital admission rates	Lower admission rates of women (20-44)	Higher admission rates of elderly (65+)	Change in hospital admission rates
	(Per cent)					
Canada	0.15	0.09	0.25	-0.48	0.23	-0.58
Newfoundland	0.13	0.07	0.29	-0.25	0.57	1.77
Prince Edward Island	0.11	0.07	0.16	-0.34	0.64	1.57
Nova Scotia	0.14	0.10	0.23	-0.43	0.44	0.63
New Brunswick	0.17	0.09	0.26	-0.70	0.34	-0.26
Quebec	0.23	0.12	0.41	-0.63	0.09	-1.24
Ontario	0.14	0.08	0.25	-0.39	0.37	-0.48
Manitoba	0.10	0.13	0.22	-0.48	0.04	-0.83
Saskatchewan	0.07	0.13	0.19	-0.28	0.14	0.02
Alberta	0.11	0.02	0.11	-0.41	0.10	-0.44
British Columbia	0.13	0.03	0.17	-0.47	0.28	0.56

NOTE The estimates in columns 3 and 6 of this table correspond to those in Table 3-1. Estimates in the other columns are based on selected elements of Appendix Table C-24 which lists estimates for all age groups, by sex, individually.
SOURCE Estimates based on data from Statistics Canada.

all provinces except Saskatchewan, administrative and supportive services contributed more to expenditure growth than inpatient care by the nursing department.

Increases in wage rates, prices of hospital supplies, and service intensity are the key elements accounting for the rise in inpatient costs for all hospital departments and service units (Table 3-4). Rising hospital wage rates accounted for about two-thirds of the increase, greater service intensity for one-quarter, and higher prices of purchased hospital supplies and services for the remaining tenth. The rank order of these three elements was the same in all provinces (Table 3-1).

Wage Rates

Higher wage rates contributed 8.2 percentage points to the per cent growth in costs per hospital patient. Roughly half of the rise in wage rates among hospital departments was attributable to nursing services, one-third to administrative and supportive services, and the remainder to diagnostic, therapeutic, and educational services (Table 3-4).

By far the most pervasive factor in the rise of hospital wage rates was economywide wage and price inflation. As the forces of "demand pull" and "cost push" raised consumer prices, major wage settlements in health and welfare, education, and manufacturing followed the same inflationary pattern, reaching peak rates of more than 20 per cent between 1973 and 1976 (Chart 3-2).

Other factors also affected hospital wage rates. The educational attainment of nurses has risen. In 1970, 4.6 per cent of all registered nurses employed by hospitals had a baccalaureate or higher degree. By 1981 the proportion had increased to 8.0 per cent. While this added to wage rate increases in earlier years, it probably had no significant impact in later years, since by 1976 the pay rates of registered nurses with and without a baccalaureate were already practically the same. During the 1970s there was also a shift towards more part-time employment of nurses – from 19 per cent in 1971 to 36 per cent in 1981. This, too, may have had a constraining effect on wage rates.

Overall, it appears that general inflation, and not educational attainment or employment status, had the

Table 3-3

Contribution of Various Hospital Services to the Growth in Hospital Operating Expenditures per Inpatient, Canada, by Province, 1961-79/80

	Canada	New-foundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskat-chewan	Alberta	British Columbia
						(Per cent)					
Inpatient Services											
Growth rate [1]	12.6	13.2	10.4	12.0	11.8	15.2	10.9	12.2	12.0	12.9	12.7
Per cent[2]	100	100	100	100	100	100	100	100	100	100	100
Nursing	44	38	45	41	43	44	44	44	50	44	46
Inpatient care	34	28	32	30	32	34	33	35	39	35	37
Surgical suite	3	2	3	3	3	3	3	3	4	3	4
Nursing administration	2	3	3	3	2	2	-	2	2	2	2
Nursery	2	2	2	2	2	2	2	2	2	2	1
Central supply	1	1	2	1	1	1	1	-	2	1	1
Obstetrical suite	1	2	2	1	2	1	1	1	1	1	1
Emergency	-	-	-	-	-	-	-	-	-	-	-
Administrative and supportive services	36	41	38	35	39	39	34	33	34	36	34
General administration	10	11	7	9	10	12	10	9	9	10	9
Dietetics	9	7	10	8	9	9	8	8	9	9	9
Plant operation	8	11	10	9	9	8	7	8	8	7	5
Housekeeping	5	6	6	4	6	5	6	5	5	5	6
Laundry	2	2	3	2	3	3	1	1	1	2	2
Medical records	2	2	1	2	1	2	2	2	2	2	2
Linen	1	1	-	1	1	-	1	1	-	1	1
Diagnostic and therapeutic services	11	9	8	12	8	11	12	13	8	11	11
Laboratory	6	5	5	8	4	5	6	6	4	5	6
Radiology	2	1	1	2	2	2	2	2	1	2	2
Pharmacy	2	1	1	1	1	2	1	2	1	1	1
Rehabilitation	1	1	2	-	1	1	1	2	1	2	2
Social work	1	1	-	1	-	1	2	1	1	1	1
Supplies and drugs	6	7	7	8	7	3	6	7	6	6	6
Medical and surgical supplies	4	4	4	5	4	2	4	4	4	3	4
Drugs	2	3	3	3	3	1	3	3	2	2	2
Education	3	5	2	4	3	3	4	4	1	3	2
Medical staff	3	3	-	3	2	3	4	3	1	2	1
Technicians and others	-	2	2	1	1	-	-	1	-	1	1

1 The growth rates in the top row of this table equal those of "cost per hospital patient" in Table 3-1.
2 Subtotals and elements of subtotals may not add up because of rounding; they are derived from the totals in Appendix Tables C-1 to C-11.
SOURCE Based on data from Statistics Canada. The underlying data series were adjusted for changes in definitions over the years.

greatest impact on hospital wage rates. There are some indications, however, that government health care programs accentuated the inflationary trends during the late 1960s and early 1970s, and that government efforts to curtail wage increases in later years did not fully succeed. During the late 1970s, hourly wage rates in hospitals advanced more rapidly than those in manufacturing.[3]

Prices

The contribution of prices to hospital operating expenditures was estimated in the same way as wage rates, by noting the price changes of supplies and services purchased by the individual service units of the major hospital departments and weighing each by its share in total hospital costs (Table 3-4).

Overall, prices contributed a little more than 1 percentage point to the 12.6 per cent growth of costs. The largest share of this increase came from administrative and supportive services and very little from nursing or diagnostic and therapeutic services. Most of the increase occurred during the 1970s. This escalation occurred primarily because of the rapid rise in prices of material supplies and such items as heating fuel and electricity.

Table 3-4

Contribution of Departmental Increases in Wage Rates, Prices, and Service Intensity to the Rise in Hospital Operating Expenditures for Inpatients, Canada, by Province, 1961-79/80

		Departmental contribution[2]			
	Total contribution[1]	Nursing services	Administrative and supportive services	Diagnostic and therapeutic services	Supplies and drugs including education
			(Per cent)		
Wage rates					
Canada	8.22	4.39	2.46	0.76	0.61
Newfoundland	6.86	3.85	2.06	0.55	0.40
Prince Edward Island	7.44	3.85	2.84	0.37	0.38
Nova Scotia	7.88	4.11	2.16	0.71	0.90
New Brunswick	7.94	4.28	2.72	0.35	0.59
Quebec	8.72	4.47	2.63	0.72	0.90
Ontario	8.33	4.41	2.31	0.82	0.79
Manitoba	8.19	4.37	2.19	0.93	0.70
Saskatchewan	7.70	4.11	2.55	0.69	0.35
Alberta	8.42	4.73	2.57	0.77	0.35
British Columbia	8.43	4.48	2.77	0.81	0.37
Prices					
Canada	1.13	0.04	0.88	0.06	0.15
Newfoundland	1.70	0.04	1.44	0.05	0.17
Prince Edward Island	1.37	0.04	1.03	0.10	0.20
Nova Scotia	1.48	0.04	1.18	0.07	0.19
New Brunswick	1.29	0.05	0.96	0.10	0.18
Quebec	0.79	0.06	0.86	0.06	0.19
Ontario	1.05	0.02	0.82	0.05	0.16
Manitoba	1.13	0.05	0.86	0.06	0.16
Saskatchewan	1.24	0.14	0.89	0.03	0.18
Alberta	1.22	0.05	0.97	0.06	0.14
British Columbia	0.92	0.02	0.72	0.04	0.14
Service intensity					
Canada	3.26	1.08	1.20	0.59	0.39
Newfoundland	4.64	1.19	1.88	0.56	1.01
Prince Edward Island	1.58	0.70	0.09	0.39	0.40
Nova Scotia	2.64	0.74	0.91	0.65	0.34
New Brunswick	2.58	0.70	0.99	0.47	0.42
Quebec	5.70	2.11	2.46	0.90	0.23
Ontario	1.56	0.31	0.58	0.49	0.18
Manitoba	2.92	0.99	0.95	0.57	0.41
Saskatchewan	3.12	1.82	0.64	0.28	0.38
Alberta	3.29	0.88	1.17	0.59	0.65
British Columbia	3.31	1.37	0.85	0.58	0.51

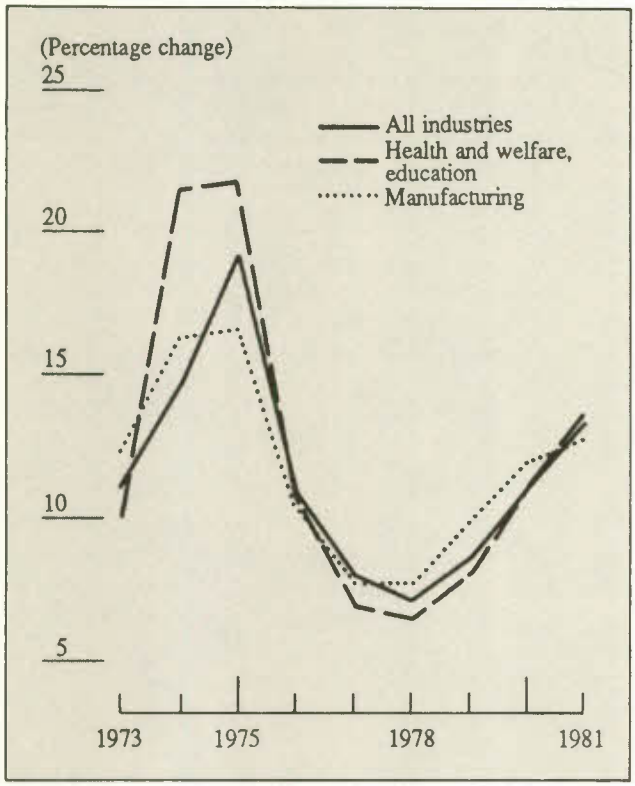
1 Estimates of total contributions correspond to those listed under "cost per hospital patient" in Table 3-1 above. For Canada, the departmental contribution of changes in wage rates, prices and service intensity amounted to 8.22 percentage points and that accounted for 8.2 of the 14.9 per cent average annual growth of total operating expenditures in Table 3-1.

2 More detailed estimates of the departmental contributions are provided in Appendix Tables C-1 to C-22.

SOURCE Estimates based on data from Statistics Canada.

Chart 3-2

Major Wage Settlements in Health and Welfare, Education; Manufacturing and All Industries, Canada, 1973-81



SOURCE Economic Council of Canada, *Lean Times: Policies and Constraints*, Nineteenth Annual Review (Ottawa: Supply and Services Canada, 1982), Table 1-6, p. 11.

In Chapter 5, we examine how much of the rise in hospital wages and prices was attributable to economy-wide trends and how much to factors specific to the hospital sector. At this time we turn to service intensity, the third major factor contributing to the rise in costs per hospital patient.

Service Intensity

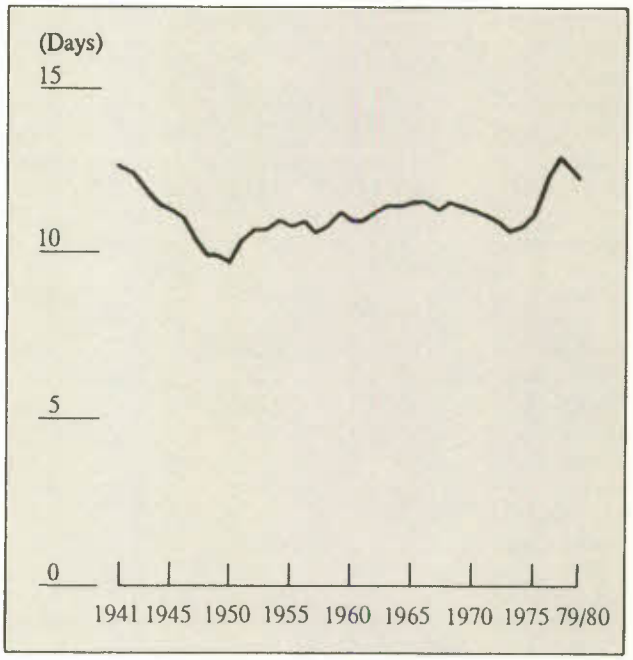
The number of hospital days is often used as a proxy for the volume of hospital services, on the assumption that the volume of hospital services varies with the number of patient-days just as the dollar cost per patient varies with the length of the stay.[4] If this were universally true, we would find that after proper allowance for wage and price inflation, hospital costs per patient would vary over time with changes in the length of hospital stays. In fact, however, the average length of stay has increased less than 1 per cent annually since 1961, while costs of hospital services per patient, net of wage and price inflation, have increased at an annual rate of 3.3 per cent.

Over the past five decades the average length of stay in Canadian hospitals has been shortened from about 18 days to 13 days or less (Chart 3-3). Most of this reduction occurred during the 1930s and 1940s, mainly because of better control of infectious disease and the introduction of antibiotics. Later adjustments were marginal. During the 1950s the average length of stay was about 11 days. It increased to a high of 11.7 days during the late 1960s, then gradually declined to 10.8 days towards the mid-1970s – a level reached once before in the 1950s – and then increased again, reaching 12 to 13 days in the early 1980s.

The increase in hospital services per patient was evident in all provinces. It was least noticeable in Ontario and most obvious in Quebec and Newfoundland. In some provinces it was fairly evenly distributed among the four major hospital departments, but generally the larger shares were associated with the nursing department

Chart 3-3

Average Length of Hospital Stay, Canada, 1941-79/80



NOTE Data for public, general and allied special hospitals; prior to 1953, estimates pertain to reporting hospitals only.
SOURCE Based on data from Statistics Canada.

and the administrative and supportive services department (Table 3-4). The rise in service intensity and some of the provincial variations in service intensity are significant and deserve further examination.

The striking discrepancy between the small changes in length of stay and the large changes in service intensity is puzzling. It could come from several sources. The productivity of hospital resources could have declined, so that more resources were required to treat the same volume of hospital patients. The quality of services could have improved, with each hospital patient receiving more intensive care. The morbidity mix of hospital patients could have changed towards diagnostic groups that required more resources per case. New technology, applied to the same diagnostic case, could have made for more intensive resource use.

On the basis of the statistics of the present study, we cannot differentiate clearly between these various sources and quantify with precision how much of the overall change in service intensity was attributable to each. But we can explore them further and thereby gain a better understanding of some of the factors contributing to the rise in service intensity.

Sources of Change in Hospital Productivity

Changes in Factor Productivity

Productivity can be evaluated in the hospital sector, as in other industries, by observing how efficiently resource inputs are converted into output. Measured productivity rises if fewer resource inputs are used to produce the same output and falls if more resource inputs are used. However, it is not possible to determine what is surely the most important measure of productivity – the improvement in the health status of the patient. Life expectancy and health expectancy are not effective substitutes, as they are quite insensitive to variations in hospital services and service intensity over time or between provinces.

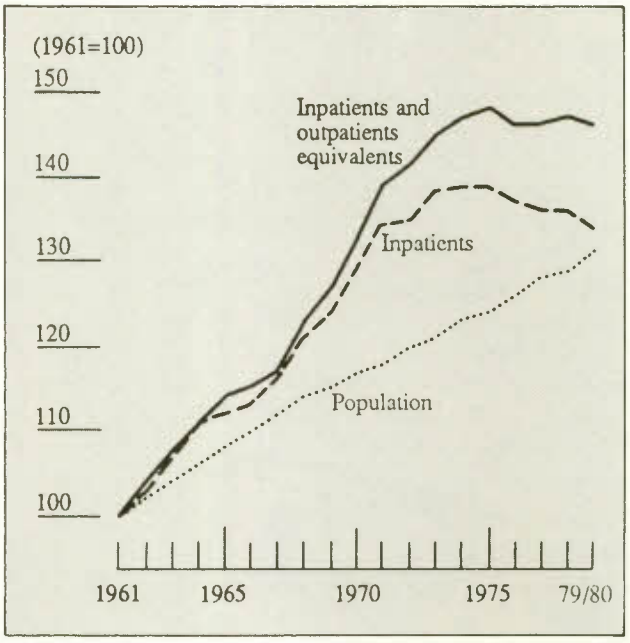
In view of these constraints, hospital output is not measured here in terms of its impact on the health status of the population but rather in terms of treatment of the ill, as measured by the volume of hospital patients. The productivity performance of hospitals is assessed by determining how much labour, capital, and material inputs are required per hospital patient, and how much this "factor productivity" has changed over the years. Changes in factor productivity, in turn, are attributed to changes in service intensity and other factors. We return to these questions later in this chapter.

Hospital output, as measured by the total volume of patients, increased from roughly 2.8 million inpatient equivalents in 1961 to 4.0 million in 1979/80, a rise of slightly more than 40 per cent.[5] Over the same period, the population grew by only about 30 per cent, from 18.2 to 23.9 million. It increased at a fairly steady rate, while the volume of hospital patients expanded more rapidly in the 1960s and then slowed down during the 1970s (Chart 3-4). Indeed, since 1973 the volume of patients has diminished. This change of pace can be attributed to two developments. During the years 1968 to 1971 the various provinces joined the new program of "free" medicare; it is likely that during that period, and perhaps for one or two years afterwards, a backlog of patients was accommodated by hospitals.

In response to the rapid escalation of costs, the federal government advocated restraint and eventually switched from cost-sharing arrangements, under which the provinces paid only half the cost increases and retained only half of any savings, to "Established Programs Financing" under which the provinces received a predetermined sum from the federal government and have therefore a stronger incentive to control costs. This seems to have encouraged more outpatient treatment and contributed to a further reduction in inpatient admissions. As the service intensity is far lower for outpatients, the change was sufficient

Chart 3-4

Growth of Population and Volume of Hospital Patients, Canada, 1961-79/80



SOURCE Based on data from Statistics Canada.

to stabilize the total volume of hospital patients during the late 1970s although outpatient numbers (and their inpatient equivalents) continued to grow.

Hospital inputs of the major factors of production – labour, capital, fuel, and materials – more than doubled between 1961 and 1979/80. Inputs of hospital personnel increased from 320 to 656 million hours. Capital stock, measured in constant dollars, increased at roughly the same rate – from $2.2 billion to $4.8 billion – and there was also a gradual shift from building construction to machinery and equipment, as the proportion of the latter expanded from 8 to 12 per cent of annual investment. Fuel and energy inputs, again measured in constant dollars, increased at a slightly faster rate than capital stock but not nearly as fast as materials and supplies, which increased almost fivefold (Chart 3-5).

In accounting for economic growth, changes in industry output can be attributed to changes in quantity of the major inputs – labour, capital, energy, and materials – relative to input and to changes in the productivity of these factors. The overall magnitude of this so-called "factor productivity" can be measured by the difference between growth rates in industry output and inputs. Applying the same estimation technique to the hospital industry, we find that over the past two decades hospital output advanced at an average annual rate of 2.1 per cent, while hospital inputs grew at a combined rate of 5.3 per cent. The factor productivity of hospitals, therefore, changed at a rate of -3.2 per cent per year. Measured in this fashion, hospital productivity did not advance but instead diminished over the years. Moreover, it appears that this decline was more rapid in recent years (Table 3-5).

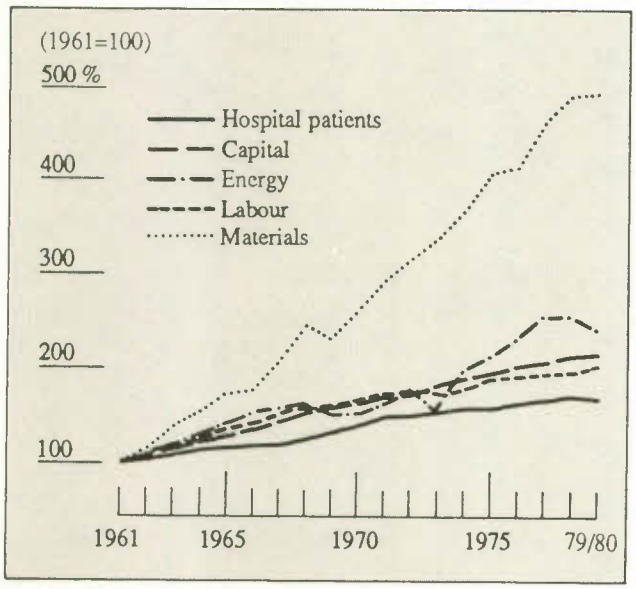
Access to New Medical Technology

This apparent long-term decline in hospital productivity is unusual not only because it differs so much from developments in other industries but also because some of the decline may have been caused by the adoption of new technology.

Historically, new industrial technology has brought improvements in productivity. The same can be said for medical technology. When antibiotics were first applied, during the 1940s and early 1950s, they reduced infectious disease, shortened hospital stays, and reduced per-patient costs. The iron lung – an intensive-care treatment – became obsolete in the late 1950s when the polio vaccine was introduced, lowering hospital admission rates and costs. Advances in biotechnology – a very recent technology based on laboratory copies of natural antibodies – hold promise of faster and more cost-effective disease therapy in the future.

Chart 3-5

Hospital Patients and Hospital Factor Inputs, Canada, 1961-79/80



SOURCE Based on data from Statistics Canada.

Table 3-5

Contribution of Factor Inputs and Factor Productivity to the Growth in Output of Public, General and Allied Special Hospitals, Canada, 1961-79/80

	Time periods		
	1961-79/80	1967-73	1973-79/80
		(Per cent)	
Factor inputs	5.3	4.8	3.4
Labour	2.5	2.1	1.7
Materials	2.0	2.1	1.1
Capital	0.7	0.6	0.5
Energy	0.1	0.0	0.1
Factor productivity	-3.2	-1.5	-3.3
Growth in hospital output[1]	2.1	3.3	0.1

1 Hospital output is defined here in terms of the "volume of hospital patients" i.e., the sum of hospital inpatients and outpatients with the latter converted into equivalents of the former on the basis of the annual cost ratios of outpatient visits to inpatient stays. Alternative estimates, based on different definitions of output, are presented in Table 3-11.

SOURCE Based on data from Statistics Canada.

But the new and very costly treatments introduced during the 1960s and 1970s – kidney transplants, heart transplants, hip joint replacements, and double or triple heart bypasses – required more intensive care. First, post-operative recovery rooms were set up near operating rooms to provide intensive care until patients came through anesthesia and the immediate after-effects of surgery. Then coronary-care units were added as it was recognized that irregularities in heart rhythm often preceded more severe heart problems and new techniques were developed to provide treatment at this stage – coagulant therapy, the pacemaker, the defibrillator, open-heart surgery, and others. Today, large, up-to-date hospitals often specialize in, or have separate units for, the intensive care of newborn babies, sick children, kidney patients, and others. These new services require more of every thing: space, equipment, laboratory tests and examinations, and, most of all, nursing time [Russell, 1979].

Each of the new and more-intensive techniques of treatment has brought new excitement and hope, and also higher cost. Conservative estimates put the cost of intensive care per hospital-day at three times that of regular ward care. Evidence of the benefits is not conclusive.

An Illustration: Bypass Surgery

In the United States, the first bypass graft for coronary heart disease was performed in 1964, and over 250,000 such procedures were performed between 1967 and 1977. All that was truly known about the procedure by 1977 was that for most patients the procedure relieved pain and improved the quality of life. There was no conclusive evidence that it lengthened life by delaying progression of hardening of the arteries except in well-selected subsets of patients. In fact, the process appeared to be accelerated in the grafted vessels [McIntosh, 1978]. In Europe, a long-term study of coronary surgery showed that for patients requiring triple bypass surgery survival was improved significantly. Survival was not improved significantly, however, for patients with single or double bypass surgery [Varnauskas et al., 1982]. Research in this area is currently underway in Canada and results should be available in the near future.[6]

Studies of the costs and benefits of new and more-intensive treatment of hospital patients are plagued by statistical problems. If hospitals with intensive-care units specialize in high-risk cases, then the real decline in post-operative mortality rates may be masked by the rise in the case severity. Furthermore, the value of surgical intervention should not be measured exclusively in terms of changes in mortality rates or life expectancy of high-risk cases. More-intensive treatment and care can also improve the quality of life for the patient. Advances have been made in the statistical assessment of case severity and quality of life, but it is not yet possible to assess changes on a provincial or national basis.

Given these imponderables, our statistical analysis does not show how much of the 3.2 per cent decline in factor productivity has come from the adoption of new and more complex technology and how much from other factors. Instead, it quantifies how much of the decline in factor productivity should be attributed to the greater intensity of hospital services and the various elements that determine service intensity.

Changes in Case Intensity

As observed earlier, the length of hospital stay since 1961 has varied over a relatively narrow range, with little or no increase throughout the years. This suggests that new medical technology may not only have made possible more complex surgical procedures and treatments but may also have shortened hospital stays. To examine this possibility, we measured changes in case intensity or volume of hospital services per patient, as explained in Chapter 2. For example, we looked at changes in surgical suite visits, babies delivered, radiology treatments, and other service units on a per-patient basis: the higher the constant-dollar cost per service unit and the greater number of service units per 100 patients, the greater the measured case intensity.

Our estimates show that case intensity increased in some departments and declined in others. In the nursing department, for example, surgical-suite visits went from 44 per cent of all hospital separations in 1961 to 47 per cent in the early 1970s and back to 46 per cent during the late 1970s. In the diagnostic and therapeutic department the number of radiological service units per 100 patients went from 133 in the early 1960s to 160 in the late 1960s and down to 144 during the late 1970s. In both cases, service intensity was higher at the end of the period than at the beginning. Deliveries in the obstetrical suite, by contrast, decreased from 15 to 9 per cent of all hospital separations and the number of nursery-days per 100 separations diminished from 100 to 57, due to the long-term decline in birth rates. The decrease in nursery-days also reflects the shorter hospital stays of newborns (Table 3-6).

Table 3-6

Examples of Changes in Case Intensity: Selected Services Provided to Hospital Patients, Canada, by Province, 1961-79/80

	Averages of subperiods			
	1961-65	1966-70	1971-75	1976-79/80
Surgical-suite visits per 100 separations[1]				
Canada	44	46	47	46
Newfoundland	34	31	35	42
Prince Edward Island	32	33	38	34
Nova Scotia	40	43	49	44
New Brunswick	38	38	42	40
Quebec	48	52	58	57
Ontario	45	47	47	45
Manitoba	40	40	40	39
Saskatchewan	36	36	34	31
Alberta	39	41	42	41
British Columbia	47	49	48	44
Radiological services[2] per 100 separations				
Canada	133	160	151	144
Newfoundland	114	125	134	124
Prince Edward Island	90	104	112	113
Nova Scotia	146	175	182	187
New Brunswick	122	151	146	139
Quebec	173	227	199	176
Ontario	131	153	141	139
Manitoba	110	125	142	129
Saskatchewan	115	129	137	126
Alberta	96	109	119	118
British Columbia	107	124	133	134
Obstetrical-suite visits per 100 separations				
Canada	15	11	9	9
Newfoundland	23	17	14	12
Prince Edward Island	16	11	8	8
Nova Scotia	17	12	10	9
New Brunswick	16	11	10	9
Quebec	16	13	11	12
Ontario	16	12	9	9
Manitoba	13	10	10	10
Saskatchewan	11	9	7	8
Alberta	14	10	8	9
British Columbia	13	10	9	9
Nursery-days[3] per 100 separations				
Canada	100	78	61	57
Newfoundland	110	106	82	62
Prince Edward Island	104	70	49	43
Nova Scotia	108	83	68	52
New Brunswick	94	73	60	54
Quebec	103	82	66	66
Ontario	109	83	62	56
Manitoba	88	66	58	57
Saskatchewan	73	55	45	46
Alberta	96	71	56	58
British Columbia	90	72	55	52

1 Separations refer to the patients discharged from hospitals.
2 Radiological services are measured in units weighted by kind of service.
3 Number of newborns per 100 separations multiplied by days of nursery stay.
SOURCE Estimates based on data from Statistics Canada.

Changes in case intensity and length of hospital stay show some similarities among the provinces. Case intensity increased most in British Columbia and Quebec, where hospital stays were lengthened, and decreased most in Prince Edward Island and Newfoundland, where hospital stays were shortened. Part of the provincial variations in the growth of hospital services and costs could therefore be explained by changes in length of hospital stay (Tables 3-7 and 3-8).

The relationship between aging of the population and case intensity is more complex. As Canada's population ages, more elderly people are being admitted to hospitals and their hospital stays are longer. Consequently, over the two decades studied elderly hospital patients account for an increasing share of hospital services. At the beginning of the 1980s nearly half of all hospital beds were occupied by patients 65 years of age or older (Chart 3-6).

The effect of aging on length of stay can be determined by measuring the change in age distribution of the hospital population and the duration of stay for patients of different age groups, and then separating these effects from changes in the length of stay of each age group over the years. Our estimates show that aging of the hospital population lengthened the average hospital stay at a rate of 1 per cent per year (Table 3-8). One-third of the change was attributable to men and two-thirds to women.

Table 3-7

Average Annual Impact of Change in Case and Task Intensity on Hospital Service Intensity, Canada, by Province, 1961-79/80

	Contribution[1]		Changes in hospital service intensity
	Case intensity	Task intensity	
	(Per cent)		
Canada	0.9	2.3	3.2
Newfoundland	-0.7	5.3	4.6
Prince Edward Island	-1.0	2.6	1.6
Nova Scotia	0.4	2.2	2.6
New Brunswick	0.5	2.1	2.6
Quebec	3.2	2.5	5.7
Ontario	-0.1	1.7	1.6
Manitoba	- -	2.9	2.9
Saskatchewan	-0.3	3.4	3.1
Alberta	0.6	2.7	3.3
British Columbia	1.5	1.8	3.3

1 Based on the more detailed estimates of Appendix Tables C-12 to C-22.
SOURCE Estimates based on data from Statistics Canada.

Table 3-8

Average Annual Impact of Aging and Age-Specific Factors on Length of Hospital Stay, Canada, by Province, 1961-79/80

	Contribution[1]		Changes in length of hospital stays
	Aging of population	Age-specific factors	
	(Per cent)		
Canada	1.0	-0.6	0.4
Newfoundland	0.9	-2.1	-1.2
Prince Edward Island	0.5	-2.5	-2.0
Nova Scotia	0.6	-0.8	-0.2
New Brunswick	0.6	0.4	1.0
Quebec	1.2	0.1	1.3
Ontario	1.3	-1.2	0.1
Manitoba	0.7	-0.4	0.3
Saskatchewan	0.5	-0.4	0.1
Alberta	0.5	-0.1	0.4
British Columbia	0.8	0.6	1.4

1 Based on the more detailed estimates of Appendix Table C-25.
SOURCE Estimates based on data from Statistics Canada.

Much of this difference between the two came from a higher incidence of long-stay diseases of the circulatory system among women and longer hospital stays of women 75 years of age and over.

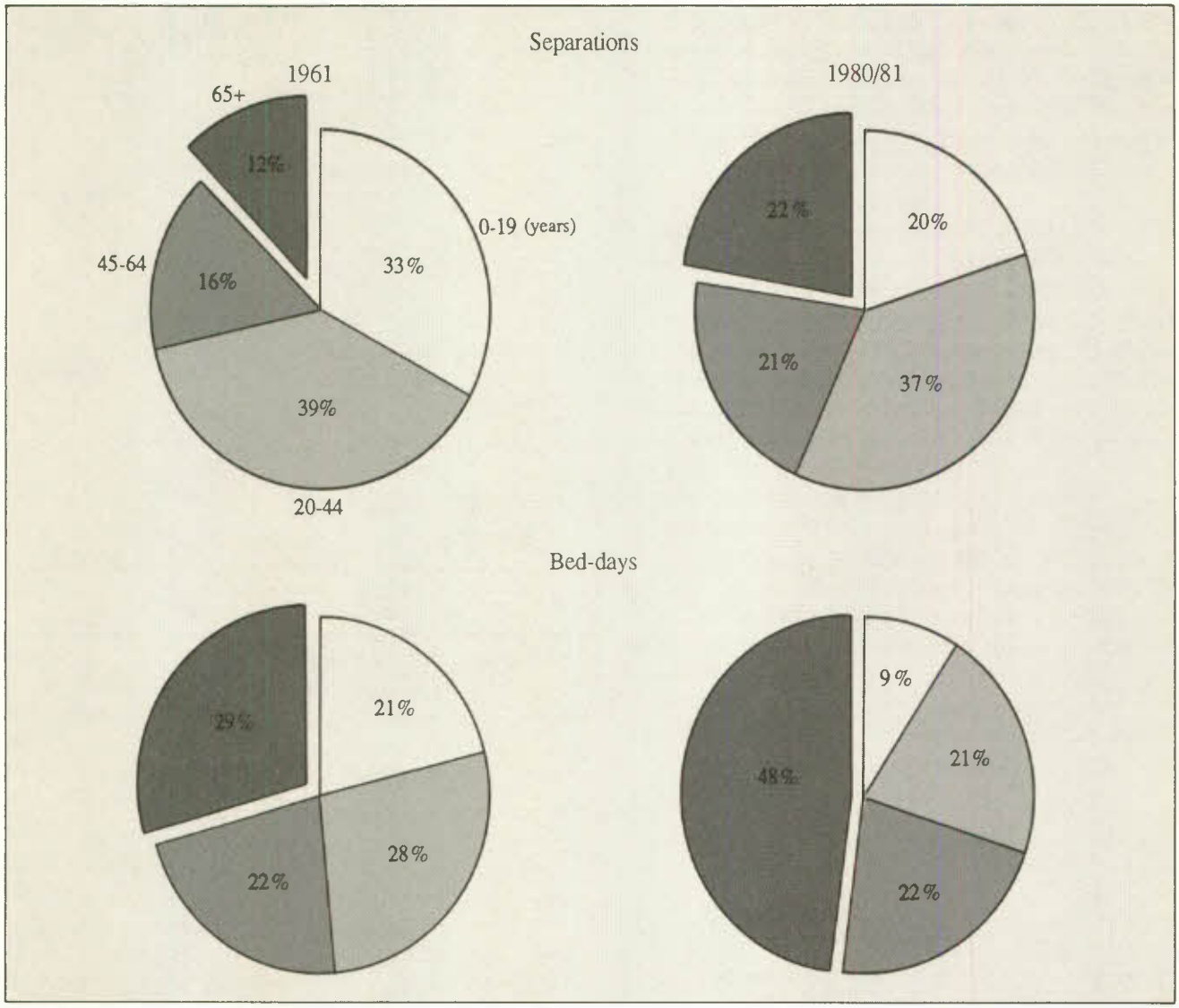
To cope with the increased demand for hospital services stemming from aging of the population, hospitals tried to reduce the length of stay of younger patients. Canada-wide, these efforts reduced the lengthening of hospital stay from 1 per cent per year to 0.4 per cent (Table 3-8). There was considerable provincial variation. Length of stay was sharply reduced in Newfoundland, Prince Edward Island and Ontario, where not only younger patients but also elderly patients had shorter hospital stays. By contrast, in British Columbia and Quebec, hospital stays of younger patients were shortened very little and stays for elderly patients continued to lengthen.[7] Obviously, there are substantial differences in cost-cutting measures between provinces, and some may reflect changes in the quality of service.

Changes in Task Intensity

The volume of hospital services per patient increased over the years, not only because more services were provided per hospital case – e.g., more laboratory tests per patient – but also because, on average, each individual service task required more inputs. Canada-wide, nursing hours per patient-day increased from three and one-third

Chart 3-6

Hospital Separations and Hospital Bed-Days by Age Group, Canada, 1961-80/81



NOTE Hospital separations refer to the number of patients discharged.
SOURCE Based on data from Statistics Canada.

hours during the early 1960s to over five hours during the late 1970s; nursing hours per surgical procedure increased from less than nine to eleven and one-half hours; nursing hours per delivery in the obstetrical suite increased from eleven to twenty-one hours; and nursing hours per "newborn-day" in the nursery increased from less than three to over five hours (Table 3-9). Taking all hospital services together, task intensity accounted for two-thirds of the increase in hospital services per patient and contributed over 2 percentage points to the annual rise in hospital costs (Table 3-7).

Unlike case intensity, task intensity increased during the last two decades in all provinces. The increase was most pronounced in Newfoundland, where task intensity accounted for one-third of the annual rise in hospital costs, contributing 5 percentage points to the average annual rise of 16 per cent in per capita expenditures. In Newfoundland, nursing hours per "inpatient-day" increased from two hours during the early 1960s to six hours in the late 1970s; in the surgical suite they increased from six to ten hours per attendance; in the obstetrical suite, from less than five hours to twenty-five hours per

Table 3-9

Examples of Increasing Task Intensity: Nursing Hours Required for Selected Hospital Tasks, Canada, by Province, 1961-79/80

	Averages of subperiods			
	1961-66	1966-71	1971-76	1976-79/80
Nursing hours per inpatient-day				
Canada	3.34	4.24	5.14	5.22
Newfoundland	2.02	3.16	5.39	6.24
Prince Edward Island	2.46	2.18	4.62	4.56
Nova Scotia	3.25	3.90	5.39	6.63
New Brunswick	3.42	4.01	5.12	5.40
Quebec	3.28	4.64	5.59	5.08
Ontario	3.82	4.44	5.08	5.28
Manitoba	3.38	4.35	5.75	6.02
Saskatchewan	1.72	2.86	4.46	4.57
Alberta	3.19	4.06	4.69	5.19
British Columbia	3.30	3.89	4.65	5.07
Nursing hours required per surgical procedure				
Canada	8.87	10.55	11.35	11.54
Newfoundland	6.49	9.00	11.88	9.79
Prince Edward Island	4.09	5.32	10.47	10.95
Nova Scotia	8.14	10.00	9.53	12.77
New Brunswick	8.09	10.19	11.33	11.13
Quebec	8.77	11.52	11.80	12.50
Ontario	10.26	11.08	11.67	11.21
Manitoba	8.59	10.09	12.86	13.13
Saskatchewan	5.77	8.75	12.11	12.51
Alberta	7.89	9.32	10.70	9.64
British Columbia	8.32	9.34	9.55	12.12
Nursing hours per delivery				
Canada	10.77	16.10	20.17	20.68
Newfoundland	3.85	6.03	19.99	25.42
Prince Edward Island	3.86	6.71	27.03	38.64
Nova Scotia	9.51	15.57	21.70	27.89
New Brunswick	10.14	18.12	21.34	25.57
Quebec	9.10	16.88	20.01	19.87
Ontario	14.10	18.88	22.13	22.04
Manitoba	10.31	14.31	21.85	25.16
Saskatchewan	5.80	10.13	16.86	15.40
Alberta	9.86	15.73	18.28	17.80
British Columbia	10.08	11.55	14.55	14.96
Nursing hours per newborn-day				
Canada	2.83	3.97	4.86	5.14
Newfoundland	1.38	1.41	3.55	4.26
Prince Edward Island	1.22	2.15	4.19	3.85
Nova Scotia	2.66	4.03	5.24	5.61
New Brunswick	3.27	4.58	5.11	5.51
Quebec	3.17	5.26	5.98	6.26
Ontario	3.16	3.88	4.51	4.56
Manitoba	2.51	3.25	5.56	6.29
Saskatchewan	1.40	2.90	4.41	4.67
Alberta	2.36	3.59	5.12	5.49
British Columbia	2.47	2.92	3.43	3.92

SOURCE Estimates based on data from Statistics Canada.

delivery; and in the nursery, from less than two hours per newborn-day to over four hours. The upward trend in task intensity was least pronounced in Ontario and British Columbia, where task intensity accounted for less than 2 per cent of annual growth and less than one-fifth of the rise in per capita expenditures (Tables 3-7 and 3-9).

The rapid increases in task intensity and the corresponding increases in hospital costs in Newfoundland and some other provinces can be attributed in part to the fact that they started out from lower levels. During the early 1960s, nursing hours per inpatient-day, per surgical procedure, per delivery, and per newborn-day were well below the national average in Newfoundland, Prince Edward Island and Saskatchewan. Over the years provincial disparities narrowed. However, some provinces that were below the national average in task intensity have now gone well beyond it. During the late 1970s nursing hours per inpatient-day surpassed the national average in three of the four Atlantic provinces; nursing hours "per visit" to the obstetrical suite exceeded the national average in all four provinces (Table 3-9).

It is tempting to speculate at this point whether greater task intensity, which accounted for most of the growth in hospital services per patient, was associated with shorter hospital stays. This would suggest a simple trade-off: the shorter the hospital stay, the more intensive the services per hospital task. There is some support for this argument. In Newfoundland, for example, hospital stays were shortened at a rate of 1.2 per cent per year (Table 3-8) while task intensity increased at a rate of 5.7 per cent (Table 3-7). In Ontario, where the length of hospital stay changed very little, task intensity changed much less than in other provinces and contributed correspondingly less to the rise in hospital costs. In Prince Edward Island, however, the length of stay was shortened even more rapidly than in Newfoundland, at a rate of 2 per cent per year, yet task intensity added much less to costs. In British Columbia the stay lengthened and task intensity was not reduced. In Quebec hospital stay was lengthened as much as in British Columbia and task intensity increased even more. The trade-off between changes in the length of hospital stay and in task intensity was not consistent among provinces.

Morbidity Mix

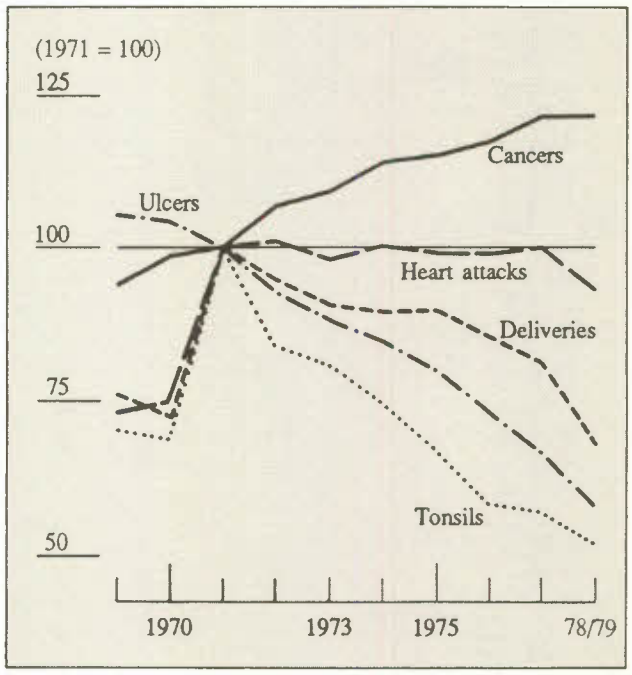
There is general agreement that the morbidity mix of hospital patients is a major determinant of hospital input requirements and costs. Highly complex cases are usually concentrated in larger hospitals equipped with special facilities. Cost variations among hospitals can be better explained, therefore, if estimates are based on diagnosis-related treatment costs.

Statistics Canada has collected hospital morbidity statistics since 1969. To determine if there were any significant shifts in Canada's hospital case mix over the past decade, we disaggregated all hospital morbidity statistics into 46 DRGs. Trends among these groups differed. The incidence of hospitalization for cancer increased from 553 cases per 100,000 population in 1971 to 674 cases in 1978, a rise of over 20 per cent in less than 10 years. Hospitalization for heart attacks increased sharply up to 1971 and remained near the 1971 level to the end of the decade. Hospitalization for treatment of ulcers and tonsils declined by about 40 per cent (Chart 3-7).

To assess the impact of these changes in case-mix patterns on the intensity of hospital services over the past decade, we applied a measure of case-mix complexity. Using diagnosis-specific estimates of hospital inputs, based on experience in the United States, we estimated how much the Canadian volume of hospital services could have been expected to change compared with a no-change case-mix pattern. By this estimation technique, a cancer treatment was rated at 1.94 times the service volume per stay and acute heart attacks, normal deliveries, peptic ulcers, and tonsils and adenoids were rated at 2.24, 0.88, 1.23, and 0.32, respectively. These five ratings and

Chart 3-7

Trends in Hospitalization for Selected Causes, Canada, 1969-78/79



SOURCE Based on data from Statistics Canada.

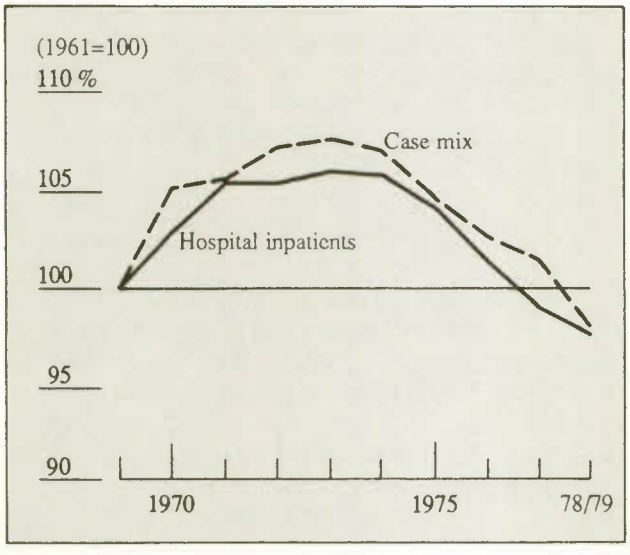
those of 41 additional diagnosis-specific groups, covering the complete spectrum of hospital morbidity, combined with the respective number of hospital admissions, yielded a measure of the annual case-mix volume of hospital services. As illustrated in Chart 3-8, the index of this volume is only slightly above the index of hospital admissions. Taken at face value, it implies that changes in the Canadian hospital case mix over the past decade raised resource requirements very little above the no-change level and explained only a very small proportion of the increase in the volume of hospital services.

Similar findings apply to all provinces. There is no evidence that changes in case-mix patterns, based on the 46 DRGs, added significantly to service requirements per hospital patient.

Because of their relatively small number, the 46 DRGs traced the changes in case-mix pattern and volume rather crudely. A more refined method based on, say, ten times as many groups might yield more homogeneous categories and better estimates of hospital resource use. The hospital statistics collected by Statistics Canada did not enable us to examine changes in hospital morbidity treatment at such a disaggregated level. It is not clear, therefore, whether our estimates of the volume of case mix differed so little from the volume of patients because changes in case-mix pattern and treatment did not have a significant impact on the use of hospital resources or because our 46 DRGs were not sensitive enough to capture them.

Chart 3-8

Volume of Case Mix and Number of Hospital Inpatients, Canada, 1969-78/79



NOTE Case-mix estimates are based on 46 DRGs as described in Chapter 2.
SOURCE Based on data from Statistics Canada.

An Illustration: Caesarean Deliveries

In examining individual elements of the rise in hospital costs per patient, an unusual combination of case intensity and task intensity was found in two of them: the obstetrical suite and the baby nursery. In both, case intensity was reduced and task intensity increased; and the cost effects were similar in magnitude, cancelling each other out.

Case intensity for obstetrical cases fell from 15 to 9 per cent of hospital admissions along with the nation-wide decline in birth rates. At the same time, task intensity increased. In the obstetrical suite, nursing assistance per delivery increased from eleven to twenty-one hours; in the nursery it increased from three to five hours per newborn-day (Table 3-9). All of the savings in hospital expenditures associated with the decline in number of deliveries were allocated to more-intensive treatment of the mother and the newborn – a trend evident in nearly all provinces (Table 3-10).

It is of interest that deliveries by caesarean section more than tripled in the last decade, from approximately 5 per cent of all hospital deliveries in 1970 to over 15 per cent in 1980/81. Part of this increase stems from the substitution of caesarean sections for deliveries by forceps and part can be attributed to the fact that more women postponed the birth of their first child to later years when birth complications are more likely to occur. Most of the increase, however, is associated with the adoption of new technology.

The rising proportion of caesarean sections has become a matter of concern [Gleicher, 1984]. Views on the necessity and desirability of performing caesareans vary widely. Routine use of the fetal monitor may have resulted in a dramatic but unnecessary increase in caesarean sections [Caire, 1978]. It is difficult to argue that caesarean deliveries have increased in response to a proportionate increase in maternal and infant problems [Placek and Taffe, 1980]; that aggressive obstetrics in low-risk patients is in the best interest of either mother or baby [Mehl, 1977]; or that if a woman has had one caesarean section this method must be used for any later pregnancies [Wadhera and Nair, 1982].

There is clearly a need for more information. According to the U.S. National Institute of Health (1981),

Table 3-10

Contribution of Case and Task Intensity to Hospital Operating Expenditures for the Obstetrical Suite and Newborn Nursery, Canada, by Province, 1961-79/80

	Case intensity		Task intensity	
	Obstetrical suite	Newborn nursery	Obstetrical suite	Newborn nursery
	(Per cent)			
Canada	-0.03	-0.06	0.04	0.06
Newfoundland	-0.06	-0.05	0.08	0.06
Prince Edward Island	-0.05	-0.09	0.11	-0.04
Nova Scotia	-0.06	-0.07	0.07	0.07
New Brunswick	-0.04	-0.06	0.07	0.05
Quebec	-0.02	-0.04	0.05	0.07
Ontario	-0.04	-0.07	0.04	0.04
Manitoba	-0.02	-0.05	0.05	0.07
Saskatchewan	-0.02	-0.05	0.06	0.13
Alberta	-0.03	-0.06	0.02	0.10
British Columbia	-0.03	-0.05	0.03	0.03

SOURCE Based on Appendix Tables C-12 to C-22 of this study; see entries under obstetrical suite and nursery of the nursing department. The negative values under "case intensity" reflect cost reductions; the positive values under "task intensity," cost increases. Associated reductions or increases in other hospital departments – e.g., administrative and supportive services, diagnostic and therapeutic services, supplies and drugs – are not inlcuded in these estimates.

information is needed in order to evaluate the best mode of delivery for fetuses in the breech position; to understand the effects of obstetric anesthesia on maternal mortality and morbidity; to improve the accuracy of diagnosis of fetal distress; and to follow up the effects of caesarean delivery on infants and their mothers after they leave the hospital. In view of maternal and neonatal mortality rates, the NIH also questions the practice of repeat caesarean births.

While medical and hospital costs are higher for a caesarean birth than for a normal birth, statistical evidence on the costs and benefits of the procedure is very sparse. According to one U.S. estimate, a caesarean section requires an extra 3.1 days of hospital stay. At 1984 rates, the additional charge per unnecessary caesarean would be at least $1,550, and each 1 per cent increase in caesarean deliveries would cost the U.S. health industry $54 million in hospital costs. These estimates do not include additional pediatrician fees for prolonged infant care, nor do they assign a dollar value to the higher risk. The maternal mortality rate for caesarean delivery still seems to be two to four times higher than that for conventional delivery – even after allowance for birth complications [Gleicher, 1984]. To some observers, it seems ironic that so much emphasis is being placed on determining the cost/benefit ratio of caesarean birth and the efficacy of electronic fetal monitoring at a time when perinatal mortality – the universally accepted indicator of perinatal care – has been greatly reduced. What must also be considered is the prevention of delivery-related birth defects by resorting to caesarean section when delivery problems are indicated [Hess, 1980].

Estimates of this type are not conclusive, since they are based on very restrictive assumptions, small samples, and global extrapolations. As opinions differ widely among leading obstetricians [Jones, 1976], a consensus on the optimal rate of caesarean sections has not yet emerged. Unless it can be shown that the desired improvement in perinatal outcomes is indeed the result of the more liberal use of the caesarean procedure, the justification for its spiralling rate is in doubt [Basket, 1978].

The Increase in Outpatient Services

The proportion of outpatient services as part of all hospital services roughly tripled in Canada during the last two decades, from about 4 per cent in 1961 to 12 per cent in 1979-80. Some outpatient services intensified over the years. Labour inputs per outpatient visit to the surgical suite increased from around 4.5 hours during the early 1960s to 5.5 hours in later years. In physical and medical rehabilitation they doubled from 0.6 to 1.2 hours per visit. For other outpatient services, labour inputs per visit remained about the same or declined. However, nonlabour inputs – i.e., materials and supplies per visit – increased for all outpatient services.[8]

Outpatient services can be grouped into three major categories: conventional outpatient services provided to ambulatory hospital patients by the outpatient department (including emergency treatment and rehabilitation services); diagnostic services, such as radiological examinations and laboratory tests, provided mainly to ambulatory patients of private-practice physicians; and surgical day-care services, provided when surgical interventions do not require hospitalization. Among these services, surgical day-care visits have increased over the years as more patients who might have been hospitalized for "light surgery" in earlier years are now treated and released on the same day.

It could be argued, therefore, that these low-intensity cases of surgical day-care ought to be included with inpatients, since their exclusion overstates the service intensity of inpatient hospital services [Boan, 1984]. Unfortunately, statistics on the morbidity and surgical treatment of outpatients are very limited. The number of surgical interventions is known, however, and can be combined with inpatient statistics. Other outpatient services can also be converted into inpatient equivalents and the overall hospital output adjusted accordingly.

Links Between Hospital Output, Service Intensity, and Productivity

Hospital productivity and hospital output are closely linked. Greater hospital output for the same resource inputs makes for greater hospital productivity. By the same token, greater *measured* hospital output makes for greater *measured* hospital productivity.

Since outpatient services have expanded more rapidly than inpatient services, we investigated how much the measured growth of hospital output and hospital productivity would change if outpatient services were measured differently.

Inpatient admissions grew from about 2.7 to 3.6 million per year over the last two decades, while outpatient services grew from roughly 3 million visits in 1961 to over 30 million in 1979/80. Taking into account the changes in numbers and mix of outpatient services, as well as the dollar cost of each – i.e., the cost of radiological examinations, laboratory tests, emergency treatments, day surgery and rehabilitative services – we converted the dollar values of annual outpatient services into annual inpatient equivalents. Measured by the combination of inpatient numbers and equivalents, hospital output advanced at an average annual rate of 2.1 per cent over these two decades (Table 3-5). When measured by adding the number of day-surgery visits to the number of inpatients, it advanced at a rate of 2.7 per cent. And when an allowance was made for other outpatient services, it advanced at a rate of 3.0 per cent. Thus, adding outpatients to inpatients enhanced the estimated growth rate of Canadian hospital output by as much as three-quarters, or from 1.7 to 3.0 per cent annually, over the past two decades. Essentially the same pattern applied to all provinces. Each successive adjustment made for a higher estimate of hospital output.

Choosing the last and most favourable measure of the growth of hospital output and subtracting from it the growth rate of the combined resource inputs yields a new estimate for hospital productivity growth of -2.3 per cent per year (Table 3-11). This is a significant improvement over the earlier estimate of -3.2 per cent, based on the combination of inpatients and inpatient equivalents of outpatients (Table 3-5), but it still shows a decline in hospital productivity. Estimated factor productivity declined because growth in hospital output – even when measured by the sum of inpatients, day-surgery visits, and inpatient equivalents for all other outpatient services – was much slower than the growth of hospital labour, materials, capital, and energy combined. Growth in factor productivity, adjusted more liberally for the growth in outpatient services, declined in all provinces (Table 3-11).

Earlier in this chapter it was shown that growth rates of case intensity varied among the provinces with changes in the length of hospital stay and that changes in length of stay were associated with changes in the age structure of the population. If we assume that all changes in case intensity resulted from the aging of Canada's population and were therefore "unavoidable," the productivity estimates should be adjusted accordingly. When that is done, the decline in factor productivity improves from -2.3 per cent to -1.4 per cent per year. Most of this adjustment, however, comes from the remarkable increase in the case intensity of hospitals in Quebec and British Columbia. In both provinces that increase was related not only to the changing age structure of the population and the associated lengthening of hospital stays, but also to other institutional adjustments which led to much longer hospital stays of the elderly (mostly of chronically ill elderly patients). But even after allowance is made for aging of the population and the institutional adjustments, a decline in factor productivity is estimated for all provinces (Table 3-11).

Factor productivity improves beyond -1.4 only if we use the most favourable estimate of hospital output and make

Table 3-11

Growth of Hospital Output, Factor Inputs, and Factor Productivity, Canada, by Province, 1961-79/80

	Average annual change										
	Canada	New-foundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskat-chewan	Alberta	British Columbia
						(Per cent)					
Hospital output[1]	3.0	5.5	3.5	3.2	2.3	2.8	3.4	1.8	0.8	3.4	3.3
Factor inputs	5.3	9.7	4.0	5.5	4.7	6.5	4.4	3.9	3.5	5.8	5.9
Labour	2.5	4.0	1.6	1.9	1.4	3.8	1.8	1.4	1.4	2.6	3.3
Materials	2.0	3.5	2.1	2.5	2.3	2.2	1.9	1.9	1.5	2.3	1.8
Capital	0.7	2.0	0.2	1.0	0.9	0.4	0.7	0.6	0.5	0.9	0.8
Energy	0.1	0.2	0.1	0.1	0.1	0.1	--	--	0.1	--	--
Factor productivity[2]	-2.3	-4.2	-0.5	-2.3	-2.4	-3.7	-1.0	-2.1	-2.7	-2.4	-2.6
Case intensity[3]	0.9	-0.7	-1.0	0.4	0.5	3.2	-0.1	0.1	-0.3	0.6	1.5
Factor productivity adjusted for case intensity[4]	-1.4	-4.9	-1.5	-1.9	-1.9	-0.5	-1.1	-2.0	-3.0	-1.8	-1.1
Task intensity[5]	2.3	5.3	2.6	2.2	2.1	2.5	1.7	2.9	3.4	2.7	1.8
Factor productivity adjusted for total service intensity[6]	0.9	0.4	0.9	0.3	0.2	2.0	0.6	0.9	0.4	0.9	0.7

1 Hospital output was estimated by adding to the number of inpatient separations the number of day-surgery visits and the inpatient cost-equivalents of the remaining outpatient services.
2 Factor productivity estimates were obtained by subtracting the growth rates of factor inputs, weighted by their cost shares, from the growth rate of hospital output.
3 Based on column 1 of Table 3-7
4 Estimates of "factor productivity adjusted for case intensity" were derived by adding the contribution of case intensity to factor productivity growth.
5 Based on column 2 of Table 3-7.
6 Estimates of "factor productivity adjusted for total service intensity" were derived by adding the contribution of case and task intensity to factor productivity growth.
SOURCE Estimates based on data from Statistics Canada.

further allowance for all increases in service intensity. In this case, factor productivity increases at an average annual rate of 0.9 per cent per year (Table 3-11, bottom line). To justify this sizable adjustment, from an average annual decline of 2.3 per cent per year over the past two decades to a rise of 0.9 per cent per year, it was necessary to make some very stringent assumptions. The rise in day surgery from 139,000 cases in 1961 to 912,000 cases in 1979/80 was counted as equivalent to a corresponding increase in the number of full-length hospital stays. And all labour and material inputs that came with greater service intensity – whether from the greater number of laboratory tests, diagnostic procedures, surgery and therapeutic treatments per patient, or more labour and material inputs per test, per surgical- or obstetrical-suite visit, or per newborn-day – were assumed to yield a corresponding hospital output.

From an economic point of view, this approach to productivity and cost/benefit analysis is debatable. To assume that greater service intensity is matched by a correspondingly greater hospital output is to assume away the fundamental productivity problem. It is analogous to assuming that more labour hours per car assembly must yield cars of superior quality. More-intensive labour use may or may not yield output of superior quality; further evidence is needed. Hospital statistics used in the context of this study do not provide it. Even much more detailed studies of specific surgical procedures, as illustrated by reference to caesarean procedures, do not provide appropriate cost/benefit estimates – at least not yet.

Nevertheless, the analysis of this chapter permits us to conclude that hospital productivity improved over the past two decades only if all of the greater service intensity, per hospital patient or per hospital task, yielded a corresponding quality improvement in the health status of hospital patients. If this quality improvement in hospital services throughout Canada amounted to no more than two-thirds of the growth rate of service intensity – or no more than 2.3 per cent per year – then there was no productivity improvement. If it amounted to less than that, hospital productivity declined. With some variations, this applied to all provinces.

4 The Levels of Hospital Costs

When national health insurance programs were first established during the late 1950s and early 1960s, residents of all ten provinces became entitled to the same basic hospital care benefits, as prescribed in the Hospital Insurance Act. At the time a consensus seemed to prevail that national standards were essential. In later years the maintenance of national standards was not considered to require uniformity of service across the country but simply the existence of certain broad principles, such as comprehensiveness of service and universality of coverage.[1]

Although this suggests that Canadian health insurance programs do not require uniform health services across the provinces, federal transfers to provinces have been based on uniform per capita allocations for many years. Established Programs Financing arrangements of the late 1970s expanded on this approach when the federal government decided to provide not only tax-point transfers, to accommodate provincial expenditure priorities more closely, but also additional per capita cash transfers to all provinces in an effort to achieve greater equality of service throughout Canada.

In view of the persistent concern about rising health care costs and the maintenance and improvement of health care, it is useful to examine provincial differences within the context of a study of hospital costs and productivity to see what has been achieved over the years in equalizing health services.

In Chapter 3 we examined provincial variations in the *growth* of hospital costs and services. This chapter looks at variations in the *levels* of costs and services. Our investigation addresses the following questions:

– How large are provincial differences in per capita hospital costs and services?

– Have the differences narrowed or widened over the years?

– Could provincial differences in the provision of health services be reduced without raising overall costs?

In looking at these questions, we used the estimation procedures described in Chapter 2. These procedures allowed us to determine how much of the provincial variations in hospital expenditures stemmed from higher or lower admission rates and how much from inpatient and outpatient services. And they allowed us to determine the extent to which variations in admission rates were conditioned by provincial variations in the age distribution of the population; how much of the cost variations resulted from variations in service intensity; and to what extent variations in hospital productivity were conditioned by provincial variations in the intensity of hospital services. In addition, we investigated the degree to which provincial variations in levels of service narrowed or widened over the years and the factors that contributed to change.

As in Chapter 3, our analysis here focuses on output, inputs and productivity within public, general and allied special hospitals, and provides information on the major hospital departments and the services provided by them.

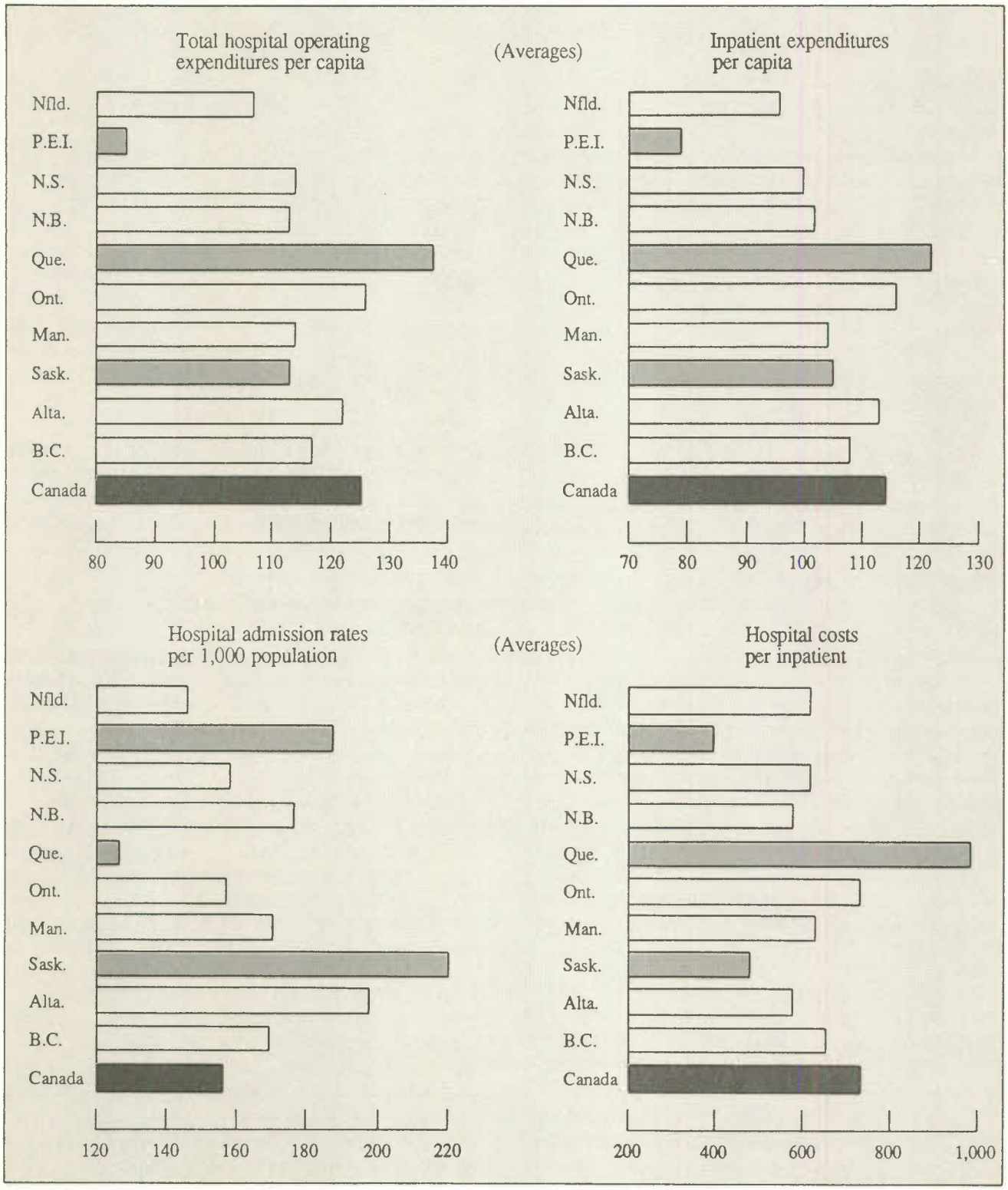
Sources of Variations in Per Capita Operating Expenditures

Provincial variations in per capita hospital expenditures have not been eliminated over the period that publicly financed insurance has been in effect. Throughout, the Atlantic provinces have been mostly below the national average, the central provinces mostly above average, and the western provinces close to average or below (Chart 4-1). In the early 1960s, per capita operating expenditures ranged from 35 per cent below the Canadian average in Newfoundland to 11 per cent above in Ontario. This range narrowed by a few percentage points during the late 1960s and early 1970s, but then widened so that by the late 1970s it was again as wide as two decades earlier (Table 4-1).

The rank order of the provinces changed, however. Up to the early 1970s, the Atlantic provinces were below the national average, the central provinces mostly above average, and the western provinces close to average or slightly below. By the late 1970s, Newfoundland had moved from the bottom of the range to the middle, Quebec had moved up to the top, and Ontario and Saskatchewan, once at the top of the range, had moved to below average. These shifts are significant, as they may be indicative of variations in hospital services. It is not

Chart 4-1

Hospital Expenditures Per Capita, Admission Rates and Costs per Hospital Patient, Canada, by Province, 1961-79/80



SOURCE Estimates based on data from Statistics Canada.

Table 4-1

Provincial Variations in Operating Expenditures Per Capita, 1961-79/80[1]

	Comparison with national average				
	1961-79/80	1961-65	1966-70	1971-75	1976-79/80
			(Dollars per capita)		
Canada	125	43	55	140	268
Newfoundland	107	28	37	120	250
Prince Edward Island	85	30	39	94	182
Nova Scotia	114	38	49	128	250
New Brunswick	113	42	52	131	238
Quebec	138	42	55	143	321
Ontario	126	48	61	147	252
Manitoba	114	42	53	132	236
Saskatchewan	113	46	57	124	251
Alberta	122	42	53	141	252
British Columbia	116	42	52	131	252
			(Difference from national average in per cent)		
Newfoundland	-20	-35	-22	-16	-7
Prince Edward Island	-31	-30	-33	-32	-32
Nova Scotia	-10	-11	-12	-9	-7
New Brunswick	-9	-4	-14	-6	-11
Quebec	6	-5	6	3	20
Ontario	4	11	6	6	-5
Manitoba	-8	-3	-10	-6	-12
Saskatchewan	-6	5	-8	-12	-12
Alberta	-2	-4	1	- -	-6
British Columbia	-7	-4	-12	-7	-6

1 The first column of this table covers the years 1961 to 1979/80; the other four columns cover three five-year periods and one four-year period. The first column of the lower panel corresponds to the top row of Table 4-2. All estimates are rounded. Because the percentage differences of the lower panel are based on average levels of *annual* data and not on the average levels of the time periods listed above, the estimates do not correspond to those of the upper panel.

SOURCE Estimates based on data by Statistics Canada.

clear at this time whether the fall to below the national average in Ontario and Saskatchewan was achieved by providing the same volume of hospital services more efficiently or simply by cutting down on services. To explore such questions, we examine the provincial differences in the various expenditure components (Table 4-2).

Hospital Admission Rates

Provincial differences in per capita hospital expenditures can be attributed to two major factors: admission rates and cost per hospital patient. Each of these, in turn, can be attributed to other factors (Chart 4-2).

Outpatient services expanded far more rapidly than inpatient admissions. The share of total hospital operating expenditures going to outpatient services increased from 4 per cent in 1961 to 12 per cent in 1979/80. However, since inpatient expenditures constituted a much larger share, they accounted for most of the provincial variations in per capita hospital expenditures. They accounted for over 90 per cent of the below-average costs in the four Atlantic provinces and Ontario, and for most of the variations among the other provinces.[2]

Since hospital admission rates varied by age and sex, we would expect part of the variation in hospital expenditures to stem from provincial differences in age structure of the population.

In 1961, Newfoundland's share of the younger age groups was 9 percentage points higher than the national average and British Columbia's share was 4 percentage points below average. Although that spread narrowed somewhat over the decades, Newfoundland's population was consistently younger and British Columbia's older than the national average.[3] One would therefore expect hospital admission rates to be similarly below or above

Table 4-2

Contribution of Various Cost Elements to Provincial Differences in Hospital Operating Expenditures, 1961-79/80[1]

	Contribution to differences from national average									
	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
	(Per cent)									
Total operating expenditures per capita, of which	-20	-31	-10	-9	6	4	-8	-6	-2	-7
Outpatient expenditures per capita	--	-3	-2	-1	2	--	-1	-2	-2	-2
Other	1	3	5	1	--	-1	--	1	--	1
Total inpatient expenditures per capita	-21	-31	-13	-9	4	5	-7	-5	--	-6
Hospital admission rates, of which	-4	11	1	10	-25	1	8	28	21	7
Age of population	-6	1	--	-1	-1	1	2	1	-2	2
Age-sex standardized factors	-2	18	--	9	-16	-1	8	37	29	4
Other factors	4	-8	1	2	-8	1	-2	-10	-6	1
Cost per hospital patient, of which	-17	-42	-14	19	29	4	-15	-33	-21	-13
Wage rates	-7	-7	-14	-12	4	1	-8	-2	-4	7
Service intensity	-10	-35	--	-7	25	3	-7	-31	-17	-20

1 The top row of this table equals the first column of the lower panel of Table 4-1.
SOURCE Estimates based on data from Statistics Canada.

the national average. This is not exactly what happened. Further analysis showed that a substantial part of Newfoundland's lower admission rates were largely attributable to its younger population, but that most of British Columbia's higher admission rates were not attributable to its older population.

Most of the provincial variation in hospital admission rates did not come from differences in age structure of the population but from variation in admission rates for the young and middle-aged. Admission rates in Prince Edward Island, Saskatchewan, and Alberta were 19, 38 and 27 per cent above the national average, while admission rates in Quebec were 17 per cent below the national average. In each case about three-quarters of the difference did not come from a larger or smaller proportion of the elderly but from higher or lower admission rates for the younger age groups (Table 4-3).

These results confirm what many international and regional studies of hospital utilization have shown, namely that large geographic variations in hospital admission rates are not readily explained by demographic characteristics. Even after full allowance is made for hospital use based on the age and sex structure of the population, most of the variations remain.[4] A small part of the variation may be due to definitional problems of hospital admissions. The large unexplained remainder is sometimes attributed to institutional traditions; to the preferences of the medical profession for more or less frequent surgical interventions; to the inability of consumers to decide what is best for them; or to an incentive system that makes for a greater volume of service but not necessarily for greater effectiveness.

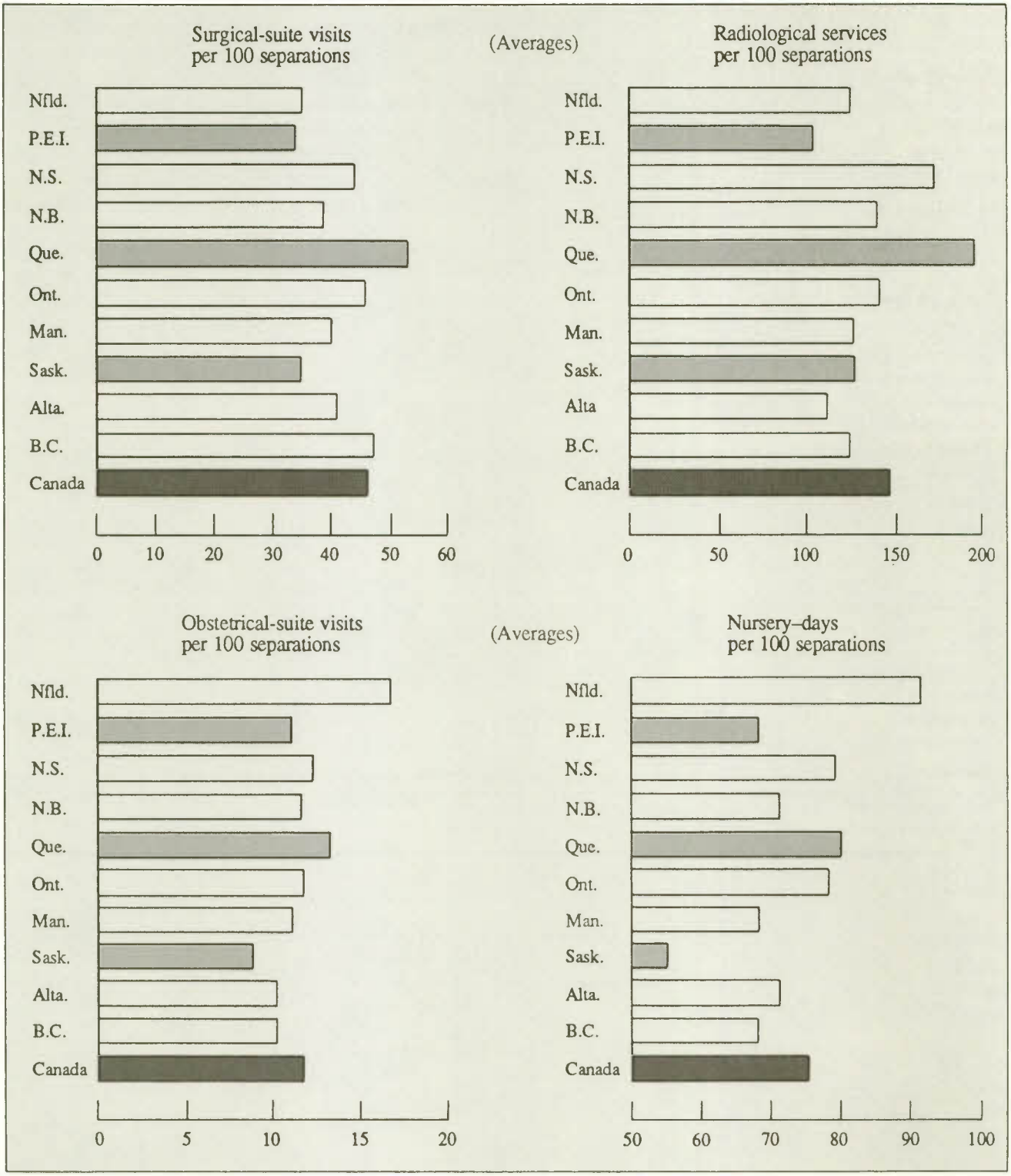
Costs per Hospital Patient

Provincial variations in hospital costs per patient contributed as much to differences in per capita operating expenditures as did variations in hospital admission rates, or even more (Table 4-2). In the Atlantic provinces, for example, hospital costs per capita were one-third lower than the national average, and lower costs per hospital patient accounted for nearly all of this difference. In Quebec and Ontario costs per capita were above average, and higher costs per patient accounted for all the difference. In the western provinces costs per capita were below average, and as in the Atlantic region, lower costs per hospital patient accounted for this.

The provincial cost patterns of Quebec and Saskatchewan were almost mirror images. Inpatient costs per capita were mostly above average in Quebec and mostly below average in Saskatchewan; admission rates were below average in Quebec and above average in Saskatchewan; and cost per patient was far above average

Chart 4-2

Examples of Provincial Variations in Case Intensity, Canada, by Province, 1961-79/80



SOURCE Estimates based on data from Statistics Canada.

Table 4-3

Contribution of Age Distribution and Other Age-Standardized Factors to Provincial Differences in Hospital Admission Rates, 1961-79/80[1]

	Contribution		
	Age distribution	Other age-standardized factors	Total
		(Per cent)	
Newfoundland	-6	-2	-8
Elderly patients	-2	-3	
Others	-4	1	
Prince Edward Island	1	18	19
Elderly patients	3	4	
Others	-2	14	
Nova Scotia	0	1	1
Elderly patients	-1	1	
Others	-1	0	
New Brunswick	-1	9	8
Elderly patients	0	1	
Others	-1	8	
Quebec	-1	-16	-17
Elderly patients	-1	-3	
Others	0	-13	
Ontario	1	-1	0
Elderly patients	0	0	
Others	1	-1	
Manitoba	2	7	9
Elderly patients	2	3	
Others	0	4	
Saskatchewan	1	37	38
Elderly patients	2	9	
Others	-1	28	
Alberta	-2	29	27
Elderly patients	-1	6	
Others	-1	23	
British Columbia	2	4	6
Elderly patients	2	0	
Others	0	4	

1 "Elderly patients" refers to those aged 65 and over. All figures have been rounded. More precise estimates, disaggregated by age and sex, appear in Appendix Table D-8. The subtotals of this table equal those listed under hospital admission rates in Table 4-2.

SOURCE Estimates based on data from Statistics Canada.

in Quebec and far below average in Saskatchewan. Compared with the early 1960s, Quebec's inpatient expenditures per capita increased relative to the national average, while Saskatchewan's decreased.[5]

Although Quebec's population was younger and Saskatchewan's older than the national average, provincial variations in the age distribution of the population had very little to do with the large differences in hospital admission rates. Given the high degree of symmetry in cost components of the provinces, it is tempting to conclude that costs per patient and admission rates were not independent of each other but that higher admission rates were linked with lower cost per patient and lower admission rates with higher costs. This inverse relation between cost per patient and admission rates is repeated, with some variations, across provinces. It applies to British Columbia, Alberta, Manitoba, New Brunswick, and Prince Edward Island, but not to Newfoundland or Ontario.[6]

We traced these cost differences to the major hospital departments. Once again, cost per patient was above average in all departments in Quebec and below average in

Saskatchewan. In both provinces, administrative and supportive services and the nursing department accounted for the largest part of the cost difference, while diagnostic and therapeutic services and supplies and drugs were of lesser importance.[7]

Wage Rates

Provincial variations in the wage rates of hospital staff contributed substantially to variations in costs per hospital patient. Below-average wage rates lowered hospital costs in the Atlantic provinces; higher wage rates added to costs in Quebec, Ontario and British Columbia; and lower wage rates reduced costs in all three Prairie provinces. In Nova Scotia, New Brunswick and Manitoba, the lower wage rates contributed more to lower hospital costs than any other single factor. In all other provinces their magnitude was of secondary order. In most of them the wage-rate variations reinforced the overall per capita cost variations (Table 4-1).

These variations did not closely resemble provincial variations in industrial wage rates. Since the 1930s, industrial wage rates have been about 5 to 10 per cent above the Canadian average in Ontario and 5 to 10 per cent below the average in Quebec. In the Atlantic provinces wage rates have gradually converged towards 70 to 85 per cent of the national average. In the West, Manitoba's wage rates have been mostly below average, Saskatchewan's about average, and Alberta's and British Columbia's above average.[8]

For the most part the contribution of hospital wage rates to provincial differences in hospital costs remained stable over the 1960s and 1970s. In Saskatchewan, Prince Edward Island and Newfoundland, however, the contribution of wage rates changed, adding to costs during the early 1960s and lowering them in later years. In all three provinces, the change came from the nursing department. In other provinces, wage rates in the nursing department and administration each contributed nearly equal proportions to provincial cost differences.[9]

Service Intensity

The contribution of service intensity[10] to provincial differences in hospital costs ranged from 35 percentage points below the national average to 25 percentage points above the average (see Table 4-2). Characteristically, service intensity was high when admission rates were low. Quebec was at one end of the interprovincial range with high service intensity and low admission rates, while Prince Edward Island and Saskatchewan were at the other end with low service intensity and high admission rates. As the variations tended to compensate for each other, they had some bearing on accessibility and possibly on the quality of hospital services.

When accessibility of hospital services was measured by age-sex standardized hospital admission rates per capita – the simplest measure of access to hospitals – changes over the past two decades made for improvement in some of the provinces but not in others. In the four Atlantic provinces, the standardized admission rates increased relative to the Canadian average and went beyond the national average during the late 1970s – an improvement over earlier years. The rates remained above the national average in all four western provinces, with Saskatchewan and Alberta well above the others, maintaining their traditional lead. In central Canada, they came closer to the national average in Ontario but fell further below the average in Quebec. Towards the end of the 1970s Quebec had the lowest admission rates in Canada and was the only province in which rates declined substantially (Table 4-4).

When accessibility of hospital services was measured by the combination of admission rates and service intensity, however, it improved relative to the Canadian average in the Atlantic provinces; remained about the same in the West, with further improvement in Saskatchewan; deteriorated in Ontario; and improved in Quebec (Table 4-4).[11]

This latter conclusion only holds, of course, if admission rates and service intensity are rated equally. If better access, as measured by higher admission rates, is valued more highly, Quebec's large rise in service intensity at the expense of a substantial reduction in hospital admission rates puts that province at a distinct disadvantage. This is an important point and we shall come back to it in Chapter 5.

Sources of Variations in Hospital Productivity

There is some doubt whether greater service intensity really makes for higher quality service. Provincial variations in productivity may be one reason. If productivity is lower in some provinces than in others, more personnel and resources will be needed to treat the same number of patients. Similarly, provincial variations will arise if patients are admitted as inpatients in some provinces who would be treated as outpatients in others. As well, variations in the age distribution of the population do not only make for variations in admission rates but also for variations in the length of hospital stay. All of these factors can affect measured service intensity without necessarily reflecting differences in quality of service.

Table 4-4

Contribution of Service Intensity and of Admission Rates to Provincial Differences in Hospital Operating Expenditures Per Capita, in Canada, by Province, 1961-79/80[1]

			Total	Contribution of	
				Service intensity[2]	Standardized admission rates
				(Per cent)	
Newfoundland	1961-79/80		-12	-10	-2
		1961-65	-46	-25	-21
		1966-70	-16	-13	-3
		1971-75	3	- -	3
		1976-79/80	14	2	12
Prince Edward Island	1961-79/80		-17	-35	18
		1961-65	-36	-38	2
		1966-70	-40	-47	7
		1971-75	-4	-24	20
		1976-79/80	17	-27	44
Nova Scotia	1961-79/80		- -	- -	- -
		1961-65	-7	- -	-7
		1966-70	-2	-2	- -
		1971-75	2	2	- -
		1976-79/80	8	- -	8
New Brunswick	1961-79/80		2	-7	9
		1961-65	- -	-5	5
		1966-70	-1	-9	8
		1971-75	7	-4	11
		1976-79/80	3	-9	12
Quebec	1961-79/80		9	25	-16
		1961-65	-1	10	-11
		1966-70	11	23	-12
		1971-75	5	24	-19
		1976-79/80	22	43	-21
Ontario	1961-79/80		2	3	-1
		1961-65	12	14	-2
		1966-70	1	7	-6
		1971-75	1	-1	2
		1976-79/80	-11	-12	1
Manitoba	1961-79/80		1	-7	8
		1961-65	3	-8	11
		1966-70	-1	-13	12
		1971-75	4	-2	6
		1976-79/80	- -	-2	2
Saskatchewan	1961-79/80		6	-31	37
		1961-65	-2	-36	34
		1966-70	2	-34	36
		1971-75	14	-24	38
		1976-79/80	13	-28	41
Alberta	1961-79/80		12	-17	29
		1961-65	5	-20	25
		1966-70	17	-17	34
		1971-75	17	-13	30
		1976-79/80	11	-16	27
British Columbia	1961-79/80		-16	-20	4
		1961-65	-13	-19	6
		1966-70	-18	-26	8
		1971-75	-20	-21	1
		1976-79/80	-12	-14	2

1 All figures have been rounded. More precise estimates, disaggregated by age and sex, appear in Appendix Table D-8.
2 The 1961-79/80 estimates of this column equal those in the bottom row of Table 4-2.
SOURCE Estimates based on data from Statistics Canada.

Output per Worker

As a first approximation in determining hospital productivity by province and for Canada, we looked at the ratio of hospital patients to staff, on the assumption that a high number of patients to hospital personnel indicates high productivity. We adjusted for outpatient services in three ways. First we combined inpatient and equivalent outpatient numbers; then we combined the number of inpatients and the number of day surgery visits, and finally we allowed for other outpatient services in addition to day surgery. The last measure is the most generous and increases the ratio by approximately one-tenth (Table 4-5).

By this last measure, hospital output in Canada averaged 14.7 inpatient equivalents per staff person-year. In other words, for every full-time member of the hospital staff, service was provided for approximately 15 patient stays per year. Provincial estimates ranged from a low of 12 patient stays per person-year in Quebec to a high of over 20 patient stays in Prince Edward Island and Saskatchewan – a range in labour productivity levels from roughly 20 per cent below the national average to 40 per cent above the average. Although there were some changes over the years, these large disparities remained about the same. If anything, the distribution became more one-sided over the years.

Factor Inputs per Worker

There was no obvious relation between factor inputs per hospital worker and variations in hospital output per worker (Table 4-6). Capital stock per hospital worker

Table 4-5

Hospital Output per Worker, Based on Different Combinations of Patients, 1961-79/80

	Hospital output per person-year[1]		
	Inpatients + outpatient equivalents	Inpatients + day surgery visits	Inpatients + day surgery visits + other outpatient visits[2]
	(Average number of patients per person-year)		
Canada	13.2	13.8	14.7
Newfoundland	16.3	17.1	18.5
Prince Edward Island	19.4	19.8	21.0
Nova Scotia	13.8	15.0	16.3
New Brunswick	14.4	15.3	16.3
Quebec	10.7	11.1	12.0
Ontario	12.9	13.4	14.3
Manitoba	13.9	15.3	16.1
Saskatchewan	18.8	19.4	20.5
Alberta	15.7	16.2	17.0
British Columbia	16.4	17.1	18.0
	(Difference from national average in per cent)		
Newfoundland	22	23	25
Prince Edward Island	48	44	43
Nova Scotia	5	9	11
New Brunswick	9	11	11
Quebec	-20	-20	-18
Ontario	-2	-2	-3
Manitoba	5	11	9
Saskatchewan	42	41	39
Alberta	19	17	15
British Columbia	24	24	22

1 Person-years were estimated (by converting personnel-hours of various hospital departments at the rate of 37 hours per week for 50 weeks) to be 1,850 hours.
2 This column equals the first column of Table 4-11.
SOURCE Estimates based on data from Statistics Canada.

Table 4-6

Capital Stock, Material, and Energy Inputs per Hospital Worker, Canada, by Province, 1961-79/80

	Factor inputs per worker			Hospital output per worker [1]
	Capital stock	Materials and supplies	Energy consumption	
	(Dollars)			
Canada	13,031	1,437	64	14.7
Newfoundland	15,632	1,801	154	18.5
Prince Edward Island	10,484	1,487	92	21.0
Nova Scotia	12,670	1,714	87	16.3
New Brunswick	11,073	1,642	81	16.3
Quebec	12,936	1,412	59	12.0
Ontario	13,471	1,448	64	14.3
Manitoba	9,827	1,365	60	16.1
Saskatchewan	13,389	1,467	57	20.5
Alberta	14,320	1,341	48	17.0
British Colombia	13,123	1,349	62	18.0
	(Difference from national average in per cent)			
Newfoundland	20	30	143	25
Prince Edward Island	-19	5	44	43
Nova Scotia	-3	19	39	11
New Brunswick	-15	11	27	11
Quebec	- -	-1	-8	-18
Ontario	3	- -	-9	-3
Manitoba	-25	-5	-7	9
Saskatchewan	3	4	-10	39
Alberta	- -	-8	-25	15
British Colombia	1	-5	-2	22

1 "Hospital output per worker" is the number of inpatients, adjusted to include the number of day-surgery visits and other outpatient visits per person-year, and is the same as the third column of Table 4-5 and the top row of Table 4-7.

SOURCE Estimates based on data from Statistics Canada.

was well below the national average in Manitoba, Prince Edward Island and New Brunswick, but output per hospital worker was well above the average. Materials, supplies, and energy consumption were above the national average in the Atlantic region and below the average in the other regions. Again, the variations in factor inputs per worker were not associated with hospital output per worker.

This implies that hospital resources contributed very little to provincial variations in hospital output per worker. The only exception was Newfoundland, where they accounted for over 10 per cent and for over half of the difference between the province and Canada in hospital output per worker. For all other provinces the corresponding differences averaged 5 per cent or less and in most cases accounted for only a very minor part of the provincial variations in hospital output per worker (Table 4-7).

One reason why resources mattered so little in accounting for the large variations in hospital output per worker was that the levels of resource inputs per worker were so low. In recent years capital stock per hospital worker varied among the provinces by as much as 60 per cent (relative to the Canadian average). However, it averaged less than $20,000 per worker, less than one-third of that in the total economy. This is far less than the quantity of capital stock per worker in the goods-producing sector and somewhat less than in the service sector or even in public administration.

Table 4-7

Contribution of Factor Inputs, Factor Productivity, and Service Intensity to Hospital Output per Worker in Canada, by Province, 1961-79/80

	New-foundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskat-chewan	Alberta	British Columbia
					(Per cent)					
Hospital output per worker	25	43	11	11	-18	-3	9	39	15	22
Capital	4	-3	--	-2	--	1	-4	--	--	--
Materials	8	1	4	2	--	--	-1	1	-2	-1
Energy	2	1	--	--	--	--	--	--	--	--
Total factor inputs per worker	14	-1	4	--	--	1	-5	1	-2	-1
Factor productivity	11	44	7	11	-18	-4	14	38	17	23
Factor productivity adjusted for case intensity	-18	-29	-11	-16	4	3	-3	-18	-9	7
Factor productivity adjusted for total service intensity	-18	-9	-9	-15	3	3	-3	-10	-8	6

SOURCE Estimates based on data from Statistics Canada.

Another reason why resource inputs mattered so little in explaining variations in hospital output per worker is that hospital technology is very different from that of other industries. In the goods-producing industries and many service industries, much of the new capital investment embodies labour-saving technology aimed at increasing the volume of output per unit of labour input. In the hospital sector new capital investment embodies medical technology designed to deliver the best care that is technically possible.[12] It is aimed at increasing the quality, not quantity, of hospital output per unit of labour input.

Factor Productivity

As in international comparisons of productivity performance, provincial comparisons of output per worker leave a large residual that is explained not by variations in factor inputs but by other characteristics. In industrial comparisons some critical elements – such as returns to scale, economies of market size, length of production runs, capacity utilization, labour quality, managerial skill, and other production characteristics – account for a substantial part of the variations in factor productivity. Some of the same elements can be identified in interprovincial comparisons of the hospital sector, but they are much less important because the largest hospitals – although located in metropolitan centres and specializing in selected treatments – are mostly teaching hospitals. Even after allowance is made for their more complex case mix, the factor productivity of these very large hospitals is generally similar and no greater than that of smaller hospitals [Horn, 1982].

Most of the interprovincial variations in factor productivity and hospital output per worker were associated with provincial differences in service intensity and particularly case intensity.

Case Intensity

Taking case intensity into account narrowed the range of variations in factor productivity to nearly one-half – from 62 to 36 per cent of the national average (Table 4-7).[13] Case intensity was above the Canadian average in Quebec and well below the average in Prince Edward Island and Saskatchewan. Hospitals supplied more service units per patient in Quebec than in any other province. Surgical interventions per 100 hospital patients averaged 53 in Quebec, compared with only 35 in Saskatchewan and 34 in Prince Edward Island. Radiological services averaged nearly 200 units per 100 hospital patients in Quebec, compared with only 125 in Saskatchewan and 100 in Prince Edward Island. Obstetrical-suite visits, nursery-days, and other indicators followed a similar pattern, with Quebec above average and most other provinces below average (Chart 4-1).

Length of Hospital Stay

It is well known that longer hospital stays make for higher costs per hospital patient. They make for higher costs because they raise case intensity. The length of hospital stay in Quebec was above the national average and accounted for not quite half of that province's 29 per cent greater case intensity than the average for Canada. Shorter hospital stays accounted for 15 of the

41 per cent below-average case intensity in Saskatchewan, and for 21 of the 45 per cent below average in Prince Edward Island. In most other provinces the length of hospital stay accounted for one-quarter to one-half of the provincial variation in case intensity. Over the years, these variations have widened. Towards the end of the 1970s Quebec's hospital stays exceeded the Canadian average by roughly 20 per cent and its case intensity exceeded the Canadian average by nearly 60 per cent (Table 4-8).

Age of Population

We would expect provinces with younger populations to have shorter hospital stays and those with older populations to have longer stays. This is what actually happened in Newfoundland and Alberta, where younger populations accounted for most of the shorter stays, and in British Columbia, where an older population accounted for one-half of the longer hospital stays. In the other seven provinces, however, variations in the length of hospital stays were linked less to age of patient than to other factors. Indeed, the age-conditioned variations in most of them ran counter to expectations. In Prince Edward Island, Nova Scotia, Manitoba and Saskatchewan, which have older populations than the average for Canada, hospital stays were shorter than average, while in Quebec, where a younger population ought to have shortened the hospital stay, stays were longer (Table 4-9).

After adjusting our findings for provincial variation in age distribution, it is evident that most of the differences in the length of hospital stays stemmed from provincial disparities in the stays of patients in identical age groups, in particular, elderly hospital patients. Shorter hospital stays by the elderly in Prince Edward Island, Nova Scotia, New Brunswick, Manitoba and Saskatchewan and longer hospital stays by the elderly in Quebec and British Columbia accounted for practically all of the difference between provincial and national average length of stays.

These provincial variations in hospital treatment are of long standing. In the four Atlantic provinces, Manitoba and Saskatchewan, hospital stays by elderly patients have been persistently shorter than average, while in Quebec they have been persistently longer. In seven provinces the length of stays by the elderly was the largest single determinant of overall variations in hospital stay. In Ontario and British Columbia the pattern of stays changed over the years. In Ontario longer than average stays by the elderly were shortened, and in British Columbia shorter stays were lengthened. Here too, the changes for elderly patients dominated the overall variations. Only Alberta did not fit this pattern. In general, the treatment of the elderly was the major determinant of provincial variations in the length of stay.

Variations in the length of hospital stay, as well as the diverging trends between Quebec and British Columbia on the one side and most other provinces on the other, revealed considerable flexibility in accommodating the provincial demand for hospital services. Only hospital admission rates showed greater variation. The main difference between the two was that hospital admission rates varied primarily because of higher or lower rates for the *younger age groups*, while the length of hospital stays varied primarily because of longer or shorter stays by the *elderly*. Neither hospital admission rates nor length of hospital stays were closely associated with the age distribution of provincial populations. They were influenced mainly by other characteristics of the provincial health care systems.

Task Intensity

Provincial variations in task intensity pertain to differences in the labour and material requirements of individual service units – e.g., nursing hours per patient-day, nursing hours per surgical-suite visit, and personnel-hours per meal-day – as well as the materials and supplies required for each. Provincially, task intensity varied by 20 per cent, or less than one-third as much as case intensity. Task intensity was above average in the Atlantic and Prairie provinces and below average in the central region and in British Columbia. Labour intensity – i.e., higher or lower labour requirements per hospital task – accounted for most of the difference (Table 4-10).

This pattern of provincial variations in task intensity was mainly associated with nursing and administrative services and much less with other hospital departments. In Newfoundland and Prince Edward Island, however, the labour requirements of the education department increased substantially, while in the province of Quebec they decreased.[14]

Morbidity Mix

One possible explanation for interprovincial variations in task intensity is the variation in morbidity patterns. Conceivably, the morbidity characteristics of patients in one province could differ from those in the next, making for different hospital treatments which could require more or less intensive hospital services. A disaggregation of the provincial case mix into 46 DRGs did not suggest that the morbidity pattern made for substantial variations in service intensity. It is quite possible, however, that the

Table 4-8

Provincial Variation in Case Intensity and in Length of Hospital Stays in Canada, by Province, 1961-79/80

		Case intensity	Length of stay[1]
		(Per cent)	
Newfoundland	1961-79/80	-25	-14
	1961-65	-12	-5
	1966-70	-15	-12
	1971-75	-28	-17
	1976-79/80	-48	-23
Prince Edward Island	1961-79/80	-45	-21
	1961-65	-36	-11
	1966-70	-39	-14
	1971-75	-46	-24
	1976-79/80	-64	-34
Nova Scotia	1961-79/80	-15	-10
	1961-65	-10	-9
	1966-70	-13	-6
	1971-75	-14	-10
	1976-79/80	-26	-13
New Brunswick	1961-79/80	-24	-6
	1961-65	-22	-11
	1966-70	-19	-10
	1971-75	-23	1
	1976-79/80	-33	-7
Quebec	1961-79/80	29	12
	1961-65	11	1
	1966-70	20	11
	1971-75	33	17
	1976-79/80	59	19
Ontario	1961-79/80	4	2
	1961-65	12	9
	1966-70	10	5
	1971-75	2	-2
	1976-79/80	-9	-6
Manitoba	1961-79/80	-15	-7
	1961-65	-10	-8
	1966-70	-15	-8
	1971-75	-17	-9
	1976-79/80	-20	-2
Saskatchewan	1961-79/80	-41	-15
	1961-65	-47	-17
	1966-70	-43	-18
	1971-75	-35	-15
	1976-79/80	-40	-11
Alberta	1961-79/80	-25	-3
	1961-65	-27	3
	1966-70	-24	-7
	1971-75	-20	-3
	1976-79/80	-33	-7
British Columbia	1961-79/80	-16	4
	1961-65	-19	-14
	1966-70	-21	-12
	1971-75	-12	-6
	1976-79/80	-11	7

1 The provincial differences in length of stays for the period 1961-79/80 correspond to those in the following table.
SOURCE Estimates based on data from Statistics Canada.

Table 4-9

Contribution of Age Distribution and Other Factors to Provincial Differences in the Length of Hospital Stays, 1961-79/80[1]

	Contribution		
	Age distribution	Other age-standardized factors	Total[2]
		(Per cent)	
Newfoundland	-13	-1	-14
Elderly patients	-7	-7	
Others	-6	6	
Prince Edward Island	6	-27	-21
Elderly patients	6	-21	
Others	0	-6	
Nova Scotia	3	-13	-10
Elderly patients	3	-13	
Others	0	0	
New Brunswick	0	-6	-6
Elderly patients	0	-9	
Others	0	6	
Quebec	-5	17	12
Elderly patients	-4	9	
Others	-1	8	
Ontario	1	1	2
Elderly patients	0	1	
Others	1	0	
Manitoba	6	-13	-7
Elderly patients	5	-7	
Others	1	-6	
Saskatchewan	7	-22	-15
Elderly patients	6	-14	
Others	1	-8	
Alberta	-2	-1	-3
Elderly patients	-1	4	
Others	-1	-5	
British Columbia	2	2	4
Elderly patients	2	7	
Others	0	-5	

1 Throughout this table "elderly patients" are considered to be those aged 65 and over; "others" include those who are under 65 years of age. All figures have been rounded. More precise estimates, disaggregated by age and sex, appear in Appendix Table D-9.
2 The elements of this column equal the 1961-79/80 estimates of length of stay in Table 4-8.
SOURCE Estimates based on data from Statistics Canada.

case mix of 46 categories was not sufficiently refined and that a further breakdown into several hundred hospital treatments and surgical procedures would have revealed a significant association between the case mix and provincial variations in service intensity.

In one particular service unit, variations in hospital treatment are quite obvious. In Newfoundland, nursing hours per delivery in the obstetrical suite increased from 6 to 25 hours from 1970 to 1980, while in Quebec and Saskatchewan they increased at a much slower rate and never reached the same level. Although the time periods are not quite comparable, we also note that during that period the rate of caesarean sections per 100 hospital deliveries advanced at a faster rate and to much higher levels in Newfoundland than in Quebec or Saskatchewan. At the beginning of the 1980s approximately one of every five babies born in Newfoundland's hospitals was delivered by caesarean section. This compares with one in six Canada-wide and only one in eight in Quebec and Saskatchewan (Chart 4-3).

Table 4-10

Contribution of Labour Intensity to Provincial Variations in Task Intensity in Canada, by Province, 1961-79/80

	Contribution					
	Nursing	Admin. + support services	Diagnostic + therapeutic services	Education	Total labour intensity	Total task intensity
			(Per cent)			
Newfoundland	5	6	2	1	14	15
Prince Edward Island	-6	6	1	8	9	11
Nova Scotia	8	6	1	1	16	15
New Brunswick	5	5	3	2	15	17
Quebec	-4	-1	--	-1	-6	-5
Ontario	1	-1	--	-2	-2	-1
Manitoba	5	3	1	1	10	9
Saskatchewan	--	6	1	1	8	11
Alberta	4	1	--	2	7	9
British Columbia	-3	-4	--	1	-6	-4

SOURCE Estimates based on data from Statistics Canada.

The higher rate of delivery by caesarean section has been attributed to many social and technical factors. In Newfoundland and Prince Edward Island it may also be attributable to the expansion of better-equipped teaching hospitals. Whatever the underlying reasons, deliveries by caesarean section require more intensive obstetrical care and more hospital resources per delivery. Although such variations in treatment procedures contribute to interprovincial variations in task intensity, other factors are also involved. In British Columbia the rate of delivery by caesarean section was about as high as in Newfoundland and Prince Edward Island, but nursing hours per delivery were substantially lower. It is quite likely, therefore, that variations in hospital productivity contributed more to interprovincial variations in task intensity than did case mix or treatment.

Links Between Levels of Hospital Output, Service Intensity, and Productivity

Earlier in this chapter, the provincial productivity of hospital personnel was measured by the number of hospital patients per personnel-year. This output measure of hospital patients included the number of inpatients and the number of outpatient visits to the surgical suite, and allowed for diagnostic, therapeutic, and other outpatient services. By this measure, hospital output per person-year varied, on average, from a low of 12 patients per person-year in Quebec to a high of 21 in Prince Edward Island, placing Quebec below the national average and all other provinces above the average (Table 4-5).

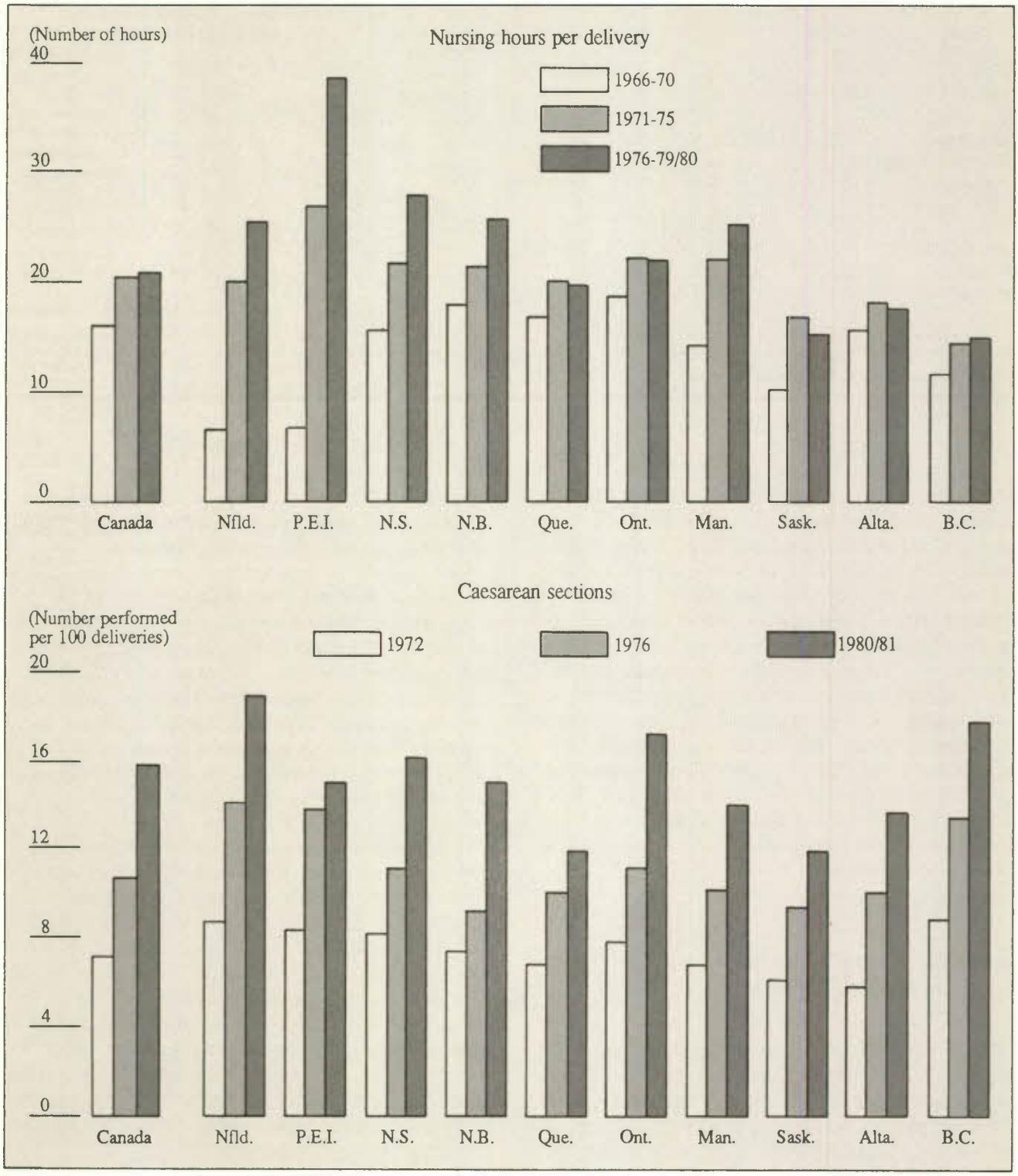
A very different set of provincial estimates of labour productivity is obtained when output is measured not by the volume of patients but by the volume of services. Based on case intensity – the more narrowly defined measure of service volume – the labour productivity of hospitals was up to 30 per cent below the national average in the Atlantic region, closer to average in the Prairie provinces, and up to 6 per cent above average in Quebec, Ontario, and British Columbia (Table 4-11).

This pattern of provincial variations in hospital output per worker, based on the volume of hospital services rather than the number of patients, corresponds more closely to the provincial variation of industrial productivity. In studies of industrial productivity, output per worker was also found to be mostly below average in the Atlantic region, close to average in the Prairie region, and above average in Ontario and British Columbia. But in contrast to industrial productivity, hospital output per worker measured by volume of service was below average in the Prairie provinces and above average in Quebec. No doubt this reflects more closely Quebec's traditional strength in medical institutions.

When measured hospital output is expanded to include both task intensity and case intensity, provincial

Chart 4-3

Nursing Hours Spent in the Obstetrical Suite per Delivery, and Rate of Caesarean Sections,[1] Canada, by Province, Selected Years



1 Number of caesarean sections per 100 hospital births.
SOURCE Based on data from Statistics Canada.

Table 4-11

Hospital Output per Worker in Canada, Based on Number of Patients and Volume of Services, by Province, 1961-79/80

	Hospital output per person-year		
	Number of patients[1]	Case volume of services	Total volume of services
		(1971 dollars)	
Canada	14.7	7,958	8,150
Newfoundland	18.5	7,727	7,881
Prince Edward Island	21.0	5,539	7,326
Nova Scotia	16.3	7,398	7,696
New Brunswick	16.3	6,673	6,909
Quebec	12.0	8,275	8,398
Ontario	14.3	8,297	8,429
Manitoba	16.1	7,363	7,359
Saskatchewan	20.5	6,619	7,417
Alberta	17.0	7,060	7,375
British Columbia	18.0	8,420	8,534
		(Difference between province and Canada in per cent)	
Newfoundland	25	-4	-4
Prince Edward Island	43	-30	-10
Nova Scotia	11	-7	-5
New Brunswick	11	-16	-15
Quebec	-18	4	3
Ontario	-3	4	4
Manitoba	9	-8	-8
Saskatchewan	39	-17	-9
Alberta	15	-11	-10
British Columbia	22	6	5

1 This column corresponds to the third column in Table 4-5.
SOURCE Estimates based on data from Statistics Canada.

variations in hospital output per worker diminish from 36 per cent to 20 per cent (Table 4-11). That, however, leaves the pattern of variation essentially unchanged, with estimated labour productivity below average in the Atlantic and Prairie regions, and above average in Quebec, Ontario and British Columbia. Nor would this pattern change much if labour productivity were adjusted for variations in capital and other hospital resources. If anything, it would lower the productivity performance of the Atlantic region still further.

Evidently the provincial variations in hospital productivity hinge on the choice of output measure. If hospital output is measured by the number of patients, one pattern of variations emerges; if it is measured by the volume of hospital services, another pattern emerges. If most of the provincial variations in case intensity are associated with better quality of service, the intermediate productivity measure – adjusted for case intensity but not for task intensity – is probably the more realistic measure of provincial variations in the labour productivity of hospitals. This measure puts British Columbia, Ontario and Quebec above the national average and the Prairie and Atlantic provinces below the national average.

5 Summary and Policy Options

In preceding chapters the rise in hospital expenditures from 1960 to 1980 was examined nationally and provincially. It was found that Canada's hospital expenditures grew at an average annual rate of 15 per cent. About two-thirds of that growth was attributed to wage and price inflation, the remaining one-third mainly to population growth and more-intensive hospital services. As Canada's population grew at an annual rate of 1.5 per cent, a similar rate of increase could be expected in hospital services. Instead, the volume of services increased at an average annual rate of 5 per cent.

Reasons for the Rise in Hospital Expenditures

Most of the increase in volume of hospital services resulted from greater service intensity per hospital patient. Considering the change in the age structure of Canada's population over the last two decades – and taking into account that elderly people are hospitalized more frequently and recover more slowly than younger people, that is perhaps what we should have expected. Indeed, there is a growing concern today that health care for Canada's aging population will require more and more hospital services and pose a major problem with respect to government financing.

Aging of the Population

Results of the statistical analysis in Chapter 3 lend little support to the notion that the change in the age structure of Canada's population has contributed significantly to the rise in Canada's hospital expenditures over the last two decades. The decline in the birth rate lowered the hospitalization rates of women in the younger age groups, and this more than compensated for the higher admission rates of the elderly. The lengthening in hospital stays associated with increased admissions of elderly patients was cancelled out by the shorter stays of younger patients. The net effect of all these changes was close to zero. This suggests that the increase in the volume of hospital services, which raised hospital costs at roughly three times the rate of population growth, must have been the result of factors other than aging of the population. In extrapolating past trends, it implies that unless birth rates continue to decline and the hospital stays of the younger age groups are shortened still further, the volume of hospital services – and thus hospital expenditures – will expand more rapidly in future as the population continues to age.

The Intensity of Hospital Services

Further analysis attributed the increase in the volume of hospital services to changes in case and task intensity. Case intensity was rated on the basis of the volume of the 23 hospital services listed in Chapter 2. Task intensity was rated according to the personnel and material requirements of each service unit – e.g., nursing hours and materials required per radiological examination, per surgical procedure, per day of nursing care, and per treatment. The more service units required per patient stay, the higher the rating of case intensity. The more personnel-hours and materials required per service unit, the higher the rating of task intensity. Taking all inpatient services into account, case and task intensity contributed roughly 1 and 2 per cent, respectively, to the average annual growth in hospital costs.

The Case Mix

To determine whether substantial shifts in morbidity patterns and hospital case mix added to service requirements, all hospital cases were assessed at the comparative costs of 46 DRGs. Trends differed among the various groups. For example, rates of hospitalization for cancer treatment increased, while those for ulcers and tonsillectomies declined. However, overall changes in the case mix over the last decade did not add significantly to service requirements.

It must be noted that a further refinement of hospital case mix into, say, ten times as many diagnosis-related groups could have yielded very different results. But even if such a disaggregation of diagnosis-related groupings had demonstrated that the case mix complexity of hospitals had indeed advanced more rapidly, that would not necessarily explain all the growth in the volume of hospital services or demonstrate an increase in hospital productivity. Productivity could only have improved if case mix complexity (and the benefits associated with it) had advanced more rapidly than service volume.

Medical Technology

Many researchers have questioned the cost-effectiveness of medical technology. At times, in fact, it has been made the sole culprit of the rise in hospital costs. Medical care is dominated by a "technological imperative" wherein tradition demands that all patients be given the best possible care and the principal constraint is not the cost but rather the state of the art, or so the argument goes [Fuchs, 1972]. Whereas other industries – e.g., automobile manufacturers – would not automatically produce the best product that engineering skills allow, but would weigh each potential improvement against the potential cost, the physician seems to be fighting a war against disease and debility in which the latest technology matters the most and cost is subordinated to winning the war.

The debate is hampered, however, by a lack of empirical evidence. Studies of long-term changes in medical and hospital treatment show that the number of diagnostic tests and therapeutic procedures administered per case have increased and that new diagnostic technologies – such as ultrasound, nuclear medicine, and fetal monitoring – have been quickly adopted, thus increasing costs. In examining the various cost elements of hospital departments and services, we found that the nursing department ranked first, administrative and supportive services a close second, and diagnostic and therapeutic services a distant third. The first two accounted for 80 per cent of the growth in hospital operating expenditures and the last for only 11 per cent. These results did not confirm the widely held belief that new diagnostic technologies were the critical factor in the rise in hospital costs. It raised a much broader question: Did the continuous rise in hospital costs come instead from a pervasive decline in hospital productivity?

As in other industries, the assessment of hospital productivity hinges on a comparison of output with resource inputs; the greater the output in response to additional resource inputs, the better the productivity performance. Ideally, hospital output should be evaluated on the basis of improvement in the health status of hospital patients. Since that is impossible, we considered substitute measures of health status, such as life expectancy and health expectancy. We found these to be neither sufficiently refined nor sensitive enough to capture quantitatively the response to variations in hospital services over the years or among provinces. Hospital output was approximated, therefore, as the number of hospital patients, adjusted for surgical day-care visits and other outpatient services.

Quantified in this manner, hospital output advanced at an average annual rate of 3 per cent, while factor inputs increased at a rate of 5.3 per cent. This meant that factor productivity declined at a rate of -2.3 per cent per year. The factor productivity of hospitals declined because the growth in the volume of hospital patients was substantially slower than that of hospital personnel, capital, and other resource inputs.

This decline in hospital productivity over the last two decades was conditioned to some extent by the output measure used. Conceivably, a measure that would capture all the benefits from advances in surgical procedures and hospital treatment would yield more favourable results. When it was assumed, for example, that all additional services provided to patients – as measured by case intensity – yielded commensurate benefits, the decline in factor productivity was reduced from -2.3 to -1.4 per cent. And when it was assumed that all changes in service intensity – as measured by case and task intensity – were matched by commensurate benefits, the factor productivity of hospitals improved at an annual rate of 0.9 per cent.

But to assume that more intensive hospital services have been automatically matched by greater hospital output is to assume away the fundamental productivity problem. More intensive services do not necessarily yield correspondingly greater output. On the contrary, it is more likely that "the law of diminishing returns" applies and that each additional unit of service input yields less and less output.

Given our limited information, it is impossible to determine whether the increase in hospital services over the last two decades yielded commensurate benefits. Service intensity in obstetrics provides an example. As birth rates have declined, deliveries of babies in hospitals have diminished accordingly. Since deliveries and birth complications require more services than many other hospital cases, this means that case intensity was reduced. Over the same period, however, nursing assistance for a delivery in the obstetrical suite increased from 11 to 21 hours, and as a result task intensity increased. In particular, as noted in Chapter 3, caesarean deliveries increased from approximately 5 per cent of all deliveries in 1970 to over 15 per cent in 1980/81. Caesareans are now the third most common operation performed on Canadian women. Although it is well known that this obstetrical procedure requires substantially more hospital services than normal delivery, the benefits over normal delivery are not clearly established and a consensus on the optimal use of this procedure has not yet emerged. Such

lack of information on the costs and benefits of a particular procedure is not an isolated case; it applies to many other procedures and advances in medical technology as well.

An optimistic belief in new technology, high expectations, and generous reimbursement schemes have fostered technologies that compensate for the incapacitating effects of diseases – e.g., coronary artery disease, stroke, cancer, emphysema, asthma, arthritis and final-stage renal disease. They can improve patients' mobility, relieve pain, and reduce anxiety, but they hardly affect the final outcome. Such "halfway technologies" are often expensive and not well evaluated. Experts in the field confirm that many technologies that have come into widespread use have later been shown to provide little or no benefit [Banta, 1987].

Economywide and Hospital-Specific Factors

The empirical evidence of this study has led to the conclusion that greater service intensity in hospital-patient treatment has contributed substantially to the rise in hospital operating expenditures, but that other, economywide factors have contributed even more. Over the last two decades, for example, general inflation accounted for 6 per cent of the growth in hospital expenditures, while population growth contributed another 1.5 per cent. Together they accounted for 7.5 per cent, or approximately one-half of the total growth. Both are "economywide" factors. In contrast, service intensity, which accounted for about 3 per cent of the expenditure growth, was conditioned by hospital-specific factors such as hospital insurance and reimbursement policies, hospital administration, and medical technology.

Over the years, the contribution of economywide and hospital-specific factors to the growth of hospital expenditures has changed significantly. From the early 1960s to the late 1970s the expenditure share attributed to economywide factors rose from 35 to 91 per cent, while that of the hospital-specific factors declined correspondingly from 65 to 9 per cent. This change-over resulted primarily from the substantial inflationary pressures that developed in the Canadian economy during the 1970s and the compensatory adjustments in hospital wage rates. Hospital wage and price inflation in the early 1960s was higher than the general rate of inflation and contributed as much as one-third to the growth in hospital expenditures, while the lower inflation in the hospital sector in later years slowed down the rate of expenditure growth (Table 5-1).

Among the provinces, the growth rates of hospital expenditures reflected economywide and hospital-specific factors to different degrees. Above-average rates of increase in British Columbia and Alberta hospital expenditures reflected mainly the economywide pressures of population growth and inflation, while above-average rates in Quebec and Newfoundland were primarily responses to hospital-specific adjustments towards greater service intensity. In Saskatchewan and Prince Edward Island, by contrast, hospital expenditures expanded at below-average rates, not so much because of slower growth in the economywide factors but because of a slower expansion in hospital-specific factors – i.e., less-inflationary hospital wage rates, and less emphasis on service intensity (Table 5-2).

In some provinces the impact of economywide factors was lessened by adjustments in the hospital-specific factors. In Alberta and Saskatchewan, population growth and inflation accelerated from the 1960s to the 1970s, but the growth rates of admissions per capita and hospital wage rates declined. Conversely, in Quebec population growth weakened but the service intensity of hospitals increased and admission rates declined. In Newfoundland, hospital services intensified and hospital-specific inflation increased, while the weak adjustments of the last few years did little to slow it down.

We conclude that in all provinces wage increases in excess of inflation and greater service intensity were the main factors contributing to the rise in hospital operating expenditures. Over the last two decades the two together doubled the pressure on hospital operating expenditures. We also conclude that demographic changes contributed very little, if anything, to the rise in costs, as higher hospital admission rates and longer stays by the elderly were cancelled out by the decline in Canada's birth rates and the compensatory adjustments in the admissions and hospital stays of the younger age groups. Since Canada's population will continue to age and birth rates will not decline forever, hospital costs (net of economywide inflation) can be expected to rise faster unless the long-term trends of hospital-specific cost increases are reversed.

We have observed that the productivity of hospitals has not improved over the years; instead it declined, whether hospital output was measured by the number of hospital patients or the case-volume of hospital services. Hospital productivity showed an improvement only when all the additional personnel-hours, and material inputs required per hospital task were credited with a corresponding value of output, and even then the improvement in hospital productivity was slight. By any measure comparable to that applied to the goods-producing industries, hospital productivity declined. We conclude, therefore, that if

Table 5-1

Factors Contributing to the Growth in Hospital Expenditures for Inpatients, Canada, 1961-79/80[1]

	Average annual growth				
	1961-66	1966-71	1971-76	1976-79/80	1961-79/80
	(Per cent)				
Growth rate of expenditures	13.5	14.5	17.7	10.8	14.5
Contribution to growth rate					
Economywide factors	4.7	5.9	12.5	9.8	8.0
Population growth	1.9	1.5	1.3	1.2	1.5
General inflation	2.3	3.8	10.5	8.5	6.0
Other factors	0.5	0.6	0.7	0.1	0.5
Hospital-specific factors	8.8	8.6	5.2	1.0	6.5
Admissions per capita	0.8	1.7	-0.7	-0.1	0.2
Hospital inflation	4.5	3.6	4.1	-1.6	3.3
Other factors	-1.0	0.8	-0.5	0.4	-0.2
Service intensity	4.5	2.5	2.3	3.5	3.2
per case	1.7	-0.5	1.6	0.5	0.9
per task	2.8	3.0	0.7	3.0	2.3
	(Contribution to growth in per cent)				
Total contribution	100	100	100	100	100
of which					
Economywide factors	35	40	71	91	55
Population growth	14	10	7	11	10
General inflation	17	26	60	79	41
Other factors	4	4	4	1	4
Hospital-specific factors	65	60	29	9	45
Admissions per capita	6	12	-4	-1	1
Hospital inflation	33	25	23	-15	23
Other factors	-7	6	-3	4	-1
Service intensity	33	17	13	33	22
per case	13	-3	9	5	6
per task	20	20	4	28	16

1 The estimates of this table relate to inpatients and, therefore, are not strictly comparable to those of Table 3-1.
SOURCE Estimates based on data from Statistics Canada.

hospital costs are to be contained in future, the productivity of hospitals must be improved. Policies need to be instituted that will provide the incentive for greater efficiency in the delivery of hospital services of the same or better quality.

Policy Options

Government policies aimed at curbing the excessive growth of health care costs have been of the "cut, freeze, and squeeze" variety and have not resulted in a basic redesign of the health care delivery system [Reuber, 1980]. There have been frequent references to instituting cheaper ways of providing medical help, eliminating duplication of services, placing greater emphasis on preventive care, modernizing existing health care facilities, and adjusting funding priorities. There have also been some references to efficiency improvements in hospitals – suggestions that hospital management should pay more attention to cost-effectiveness and should implement techniques that have yielded significant economies in the private sector. But there has been no general agreement on how the system should be redesigned or what specific adjustments should be made first.

Expressing concern about the continuous rise in hospital costs and advocating cost control through productivity improvements are two different things. Because of the

Table 5-2

Factors Contributing to the Growth in Hospital Operating Expenditures for Inpatients, Canada, by Province, 1961-79/80

	Contribution to growth										
	Economywide factors				Hospital-specific factors						
							Service intensity				
	Population growth	General inflation	Other factors	Sub-total	Admissions per capita	Hospital inflation	Per case	Per task	Other factors	Sub-total	Total growth
	(Per cent)										
Canada[1]	1.5	6.0	0.5	8.0	0.2	3.3	0.9	2.3	-0.2	6.5	14.5
Newfoundland	1.2	6.1	0.7	8.0	2.3	2.5	-0.6	5.3	-0.3	9.2	17.2
Prince Edward Island	0.9	6.8	0.3	8.0	1.8	1.9	-1.0	2.7	-0.4	5.0	13.0
Nova Scotia	0.8	6.3	0.5	7.6	1.0	3.0	0.4	2.3	-0.1	6.6	14.2
New Brunswick	0.8	7.0	0.2	8.0	- -	2.3	0.4	2.2	-0.3	4.6	12.6
Quebec	1.0	5.8	0.5	7.3	0.1	3.8	3.2	2.5	-0.6	9.0	16.3
Ontario	1.8	5.6	0.4	7.8	0.3	3.8	-0.1	1.7	0.2	5.9	13.7
Manitoba	0.6	5.9	0.3	6.8	-0.4	3.4	0.1	2.9	-0.3	5.7	12.5
Saskatchewan	0.2	7.4	-0.2	7.4	0.1	1.6	-0.3	3.4	-0.7	4.1	11.5
Alberta	2.5	7.3	0.5	10.3	-0.3	2.3	0.6	2.7	-0.2	5.1	15.4
British Columbia	2.7	6.2	0.6	9.5	-0.3	3.2	1.5	1.9	-0.5	5.8	15.3

1 The estimates in the first row of this table correspond to those in the last column of Table 5-1.
SOURCE Estimates based on data from Statistics Canada.

difficulties of applying standards to particular services, governments are forced to adopt across-the-board measures. Any attempts to improve the cost-effectiveness of hospital services by changing productivity performance are hampered by methods of accounting and hospital budget control. The per diem rate, still dominant today, was first introduced over a century ago when institutional care consisted primarily of custodial care for the indigent. The cost-setting techniques of today continue to be based on that antiquated method.

The principal cause of rising health expenditures in Canada is essentially the same as in the United States. By far the largest share of health expenditures is attributable to hospitals and physicians, and the traditional reimbursement system has been giving the wrong incentive signals. For many years, the health insurance system has paid the costs: the more it cost, the more the system paid. Although government-imposed restraints kept outlays from rising as fast in Canada as in the United States during the 1970s, neither the Canadian nor the U.S. system automatically corrected for the wrong incentive signals. Generally speaking, hospitals that operated more efficiently and cut costs received less funding, while others that operated less efficiently received more.

Treatment-Oriented Accounting Systems

New treatment-oriented hospital accounting systems with payment schedules based on the fee schedules of DRGs provide an incentive for more cost-effective management. Such a DRG system is currently being introduced in the United States.[1] It is being phased in over a four-year period and should be completed by 1988.[2] Implementation of a similar system is being seriously considered in some parts of Canada.

The new U.S. payment system is based on 467 DRGs, with payments based on national averages (and regional variations) of treatment costs per patient. If, for example, the national average for a hip joint replacement is $5,000 and the actual cost to a hospital is less it can keep the difference, and if the cost is more the hospital has a loss. Advocates of this system believe that because hospitals are allowed to retain any savings, they have a strong incentive to work with physicians in minimizing the length of hospital stays and eliminating excessive resource use or other factors that would otherwise add to treatment costs. The payment system does not apply to capital-related costs or to costs of medical education, which are reimbursed separately on a reasonable cost basis. It also does not apply to psychiatric, pediatric, and

long-term-care hospitals, or to cases that are very costly and require hospital stays of over 30 days. Those expenditures will continue to be reimbursed, as under the traditional repayment system. Adjustments in payment will allow for wage-rate and cost variations among states and regions.[3] States that have equally stringent hospital-cost containment programs will be exempt from the system.[4]

The DRG-based reimbursement for hospital services promotes greater cost-consciousness. It replaces the misleading simplicity of the number of patient-days as a unit of account with the number of case episodes and the case mix. This should make it easier to identify departures from clinically appropriate norms and from costs per unit of hospital output. Moreover, it should provide an incentive to reduce the cost per case, since hospitals are allowed to share the surplus.

Nevertheless, critics claim that the DRG system has its flaws. Some cases will prove to be more profitable than others, and by adjusting their case mix, hospitals could produce greater returns. By selecting the more profitable of the primary and secondary diagnoses, hospitals could cause a change in DRG mix and thereby raise revenues. According to one author, this new hospital-acquired disease of DRG creep could assume epidemic proportions in the 1980s, so that in the end it would be difficult to distinguish the disease from the cure [Simbourg, 1981]. So far, at least, that is not what has happened.

Others are sceptical about the use of DRGs as a tool of cost containment, because reimbursement that is sensitive to case mix does not satisfy some basic principles of management control. An optimal control system should be fair and should reward good decisions. A hospital management decision to cut down on admissions – whether good or bad in terms of quality of care – would be penalized automatically, because a hospital must maintain its volume to recover its fixed costs. Also, management goals should be consistent across operating divisions; in hospitals they are not. Traditionally, physicians have sought to provide the best-quality care, with little regard to cost, leaving the financial decisions to management. The DRG system will not change that, but it will accentuate the problem. As well, control and responsibility should be in the same hands; in hospitals they are not. Control over case mix and clinical decisions rests with physicians, while responsibility for the financial impact of these decisions rests with hospital management. There is the danger, therefore, that the DRG reimbursement system will require physicians to perform according to norms that emphasize quantity rather than quality [Young and Saltman, 1982].

These treatment-oriented accounting systems and payment schedules could be a desirable development for Canada, after initial testing and possibly further refinement. Governments could encourage hospitals to switch to such systems by providing technical assistance and reimbursing individual hospitals for the start-up costs.

Under the DRG system, as presently implemented in the United States, hospitals that treat more severe cases and use more resources may suffer financially. If their present budgets are more than adequate, this may not pose a problem but may simply cut out some of the surplus. However, it could pose a more serious problem for Canadian hospitals, as they are already on tighter budgets than their U.S. counterparts. If a case-mix reimbursement system were to be introduced in Canada, it could allow for that by coupling the DRG system with a case-severity index. Even if it were not to become obligatory, a system that would measure and record changes in case mix and severity from year to year and among institutions, could be very useful for internal management control and for hospital budget decisions.[5] If it were put into effect Canada-wide national health expenditures could be monitored more closely than is possible today.

Judging from the U.S. experience, a DRG system could effectively cut down on excessive diagnostic testing and lower the use of more costly interventions where other treatments are judged equally effective. It could also shorten the average length of hospital stays, which could lower costs per case so long as the savings from shorter stays are not outweighted by cost increases from additional diagnostic tests or therapeutic procedures [Showstack et al., 1982]. This system would not necessarily lower the rates of coronary bypasses, radical mastectomies, fetal monitoring, and caesarean sections, although there is wide disagreement as to the appropriate application of these procedures.[6] What is more likely is that the cost per case would fall due to closer scrutiny of hospital procedures and treatments.

Prepaid Health Care Plans and Group Practices

Prepaid health care plans are based on prospective reimbursement for health care costs per year. While the DRG system is aimed at controlling the cost per hospital admission, the prepaid health care system is aimed at controlling the annual health care cost per member of a group.

The simplest and most common of the prepaid health care systems are the Health Maintenance Organizations

(HMOs). For a fixed sum of money, HMOs provide their members with insurance coverage of bills from doctors and hospitals. Under this system, HMO physicians provide services on a prepaid basis. If they can provide the service for less than the prospective payments of their HMO members, they make a profit; if not, they break even or lose money. Costs can be curbed by avoiding unnecessary hospitalization and excessive treatment, as well as by providing regular checkups, preventive health care, and early diagnosis of potentially serious illness.[7]

Although HMOs have existed in the United States for many years, their growth has accelerated over the past decade. A major turning point came when the HMO Act was instituted in 1973 and financial assistance was made available to new HMOs by the U.S. government. From 1974 to 1984 enrolment in HMOs grew from 5 to 15 million. Another reason for the dramatic increase is that some of the largest health insurers and hospital development companies, including Prudential, Blue Shield, Blue Cross, and even hospital chains like Humana, have established or are in support of HMOs. As well, in recent years the surplus of physicians and imbalances in certain specialties have made the medical profession more receptive to HMOs. And, of course, the financial incentives are appealing to consumers. Patients are provided health services at favourable rates, without having to pay deductibles or co-payments up front.

In response to the rapid expansion of the HMOs, Preferred Provider Organizations (PPOs) have cropped up in the United States. The PPOs furnish physician and hospital services to consumers on a contract basis at a discount rate. Several states have passed laws to encourage their development. Health insurers such as Prudential, Blue Shield and Blue Cross are also participating by setting up their own PPOs or by contracting with existing PPOs on behalf of their clients. Under this system, consumers may choose their own physicians and hospitals but there is an incentive to use certain providers – usually in the form of a waiver of co-payments or deductibles. The providers, in turn, are assured of a steady patient supply and are not locked into a fixed-salary or per capita system.[8]

The advantages of prepaid health care or group plans are less obvious for Canadians, since they are not at the same risk as their U.S. counterparts. Community Health Centers (CHCs) in Canada have little control over the use of outside services by their members and would therefore be at greater financial risk than HMOs in the United States. Also, it is questioned whether a greater number of CHCs would generate a significant reduction in Canada's health care costs through lower hospital admission rates. An exploratory study of CHCs conducted in Ontario, for example, suggests that greater use of CHCs would not have much effect on hospital costs.[9]

Although CHCs do receive financial support from government, they are not very popular – partly because many physicians are unwilling to work on a salary or a rate based on membership in the program (capitation payments) and partly because consumers already have unrestricted access to conventional health care services. To make such health care centres more attractive to consumers, a different incentive system would be needed. Assuming for the moment that health care centres would indeed reduce overall health care costs, refunds could be granted by government to clients who committed themselves by annual contract to use their services. Since we do not know at present how much more cost-effective such services would be or how strongly producers and consumers would react to capitation incentives and tax refunds, governments could sponsor them on a trial basis. If necessary, they could be directly associated with the operation of certain hospitals, also selected on a trial basis, so that physician services and hospital treatment could be vertically integrated.

Market Competition and Adjustment

Since 1980, insurance companies in the United States have raised their policy premiums by 25 to 35 per cent. To corporations that pay most, or sometimes all, of their employees' premiums, that trend is alarming. In some instances the amounts are large enough to dull the competitive edge. Last year, General Motors in the United States spent over $2 billion on employees' health insurance premiums – about three-quarters of what it paid for steel to build cars.[10] In the search for lower-priced alternatives, many companies have encouraged their employees to opt for HMOs. As yet, only 7 per cent of health insurance clientele are covered by HMOs. While this leaves ample room for expansion, it is by no means clear that HMOs will ever dominate the market. Most HMOs save money by having lower hospitalization rates than other benefit plans, but it is not clear why their rates are lower. If HMOs used hospitals less because they do more to prevent disease, they would be more cost-effective providers. But if they achieved better results because their clientele was healthier to begin with, they would not necessarily be superior to other providers. As yet, the evidence is inconclusive [Herzlinger, 1985].

Some would claim that HMOs, PPOs, and hospital chains achieved nearly all the savings they could by

cutting back on unnecessary hospital admissions.[11] After growing at an average annual rate of 2.3 per cent per year during the late 1970s, U.S. hospital admission rates flattened and dropped off in the early 1980s. In 1984, changes in medicare and corporate health-benefit programs took hold and hospital admissions dropped by 5 per cent. Average hospital occupancy rates dropped from 76 per cent in 1980 to 68 per cent in 1984.

Hospitals are attempting to adjust their operations to the empty beds by substituting more ambulatory surgery and adding more outpatient facilities. Major hospital chains cut back on staffing, supplies and equipment purchases, and managed to keep profits growing. Expansion by vertical integration made it possible for them to keep their treatment costs below the average and to make a profit. To capture an even larger market share, they may have to integrate emergency-care centres, nursing homes, home care, and even surgical supplies and equipment makers – an area most affected by the uncertainties of medicare reimbursement.[12]

This description may convey the impression that competition between the various health care organizations made for some drastic adjustments in the United States which are badly needed in Canada now. A glance at a Canada-U.S. comparison of hospital expenditures reveals that, in fact, Canada made some of these adjustments several years ago. During the 1970s hospital expenditures in both countries grew at an average annual rate of 15 per cent, doubling every five years. However, Canada had a higher rate of inflation and a higher rate of population growth; two economywide factors impacting on hospital costs. Inflation and population growth accounted for 76 per cent of expenditure growth in Canada but only 59 per cent in the United States.

Increases in hospital prices, wages and service intensity added about the same to the rise in costs in Canada and the United States. The principal difference among hospital-specific factors was that hospital admission rates declined in Canada and increased in the United States (Table 5-3).

The description above may also give the impression that private hospitals and hospital chains made a major impact because of their large share of U.S. hospitals. Although the services, sales and profits of private hospitals have increased rapidly and their share of hospitals expanded from 18 per cent in 1979 to 22 per cent in 1984, over three-quarters of all hospitals in the United States are public. The share of public hospitals may shrink some more in future, but reliance on market forces may not remain as popular as it is now. It is well known that private hospitals do not give equal access to the poor, particularly when they are chronically ill. Only about 3 per cent of private hospital revenues come from needy patients, compared with 11 per cent in city- and state-owned public hospitals.[13] Nor is it clearly established that private hospitals provide better care at lower

Table 5-3

Economywide and Hospital-Specific Factors Contributing to the Growth in Hospital Operating Expenditures for Inpatients, Canada and United States, 1971-81[1]

	Growth and contributing factors	
	Canada	United States
	(Contribution to growth in per cent)	
Average annual growth rate	15.1	15.2
Total growth	100	100
Economywide factors	76	59
General inflation	67	52
Aggregate population growth	9	7
Hospital-specific factors	24	41
Hospital-input prices and wages in excess of general inflation	15	12
Admissions per capita	-9	8
Service intensity	18	21

1 Canadian estimates relate to the period 1971-79/80; U.S. estimates, to the period 1971-81. For this reason and because of differences in estimation procedures, the two sets of estimates are not strictly comparable.

SOURCE Canadian estimates are based on data from Statistics Canada; U.S estimates on M. S. Freeland and C. E. Schendler, "National health expenditure growth in the 1980s: An aging population, new technologies, and increasing competition," in *Health Care Financing Review* 4, No. 3 (March 1983):1-57.

cost. According to a study sponsored by the U.S. government, for-profit hospitals produced a good part of their revenues by performing extra services, charging higher prices, and collecting bills more aggressively. The cost of caring for the average patient at for-profit hospitals was estimated to be at least 2 per cent higher, and the cost of extra services 24 per cent higher than at non-profit hospitals. Moreover, the hospital chains charged patients 17 per cent more than it cost for their care, while non-profit hospitals did not quite break even.[14]

In some of the states, responsibility for the poor rests with local governments, and health care for them is provided by county hospitals. Those hospitals have declined in numbers because funding has become tighter. At the same time, the number of medically indigent patients per county hospital has risen and the pressure from private and district hospitals to take on their charitable cases has increased. Not surprisingly, therefore, administrators of county hospitals, as well as city and state hospitals, have expressed concern that if the private chains take away all the lucrative services, it will become more and more difficult for them to tend to the poor. If profits are the measuring stick, private chains are operated more efficiently; but if costs and welfare benefits to society are measured as well, they are not.

According to one health economist, the United States is now in the midst of a revolution of health care finance. The problems it addresses are over-utilization of medical services, inadequate evaluation of new technologies, inefficient and inequitable cross-subsidization, and excess supplies of specialists and hospital beds. But, as with all revolutions, this one carries within it the seeds of its own destruction: inadequate insurance coverage for millions, the erosion of professional ethics as an instrument of control, loss of trust between physicians and patients, and a decline in medical research.[15]

Cost/Benefit Approach to Treatments

Heart disease is the number one killer in North America, and the coronary bypass has become one of the most common operations. The operation is remarkably successful, since 90 per cent of patients are able to resume near-normal lives.

According to some, however, bypass surgery is merely another surgical fad in medical history that, like tonsillectomies and ulcer operations, will eventually be seen not as the best remedy of its kind, but as a special procedure appropriate only when less interventionist treatments are not sufficient. A U.S. government study found that 25,000 bypasses, one in every eight, were not necessary, since they did not significantly improve the patients' chances of survival. At an average cost of $15,000 to $25,000 per bypass, these unnecessary operations could have cost as much as $500 million per year.[16]

In part, technology is to blame. As David Suzuki put it, reflecting on a personal tragedy:[17]

> Modern science and medicine are driven by the compulsion to dominate and control. For the doctor, every successful treatment of a patient represents a triumph over nature, a defeat of death.... But how far do we go?...
>
> On April 25, 1984, my mother died, instantly, of a massive heart attack. On May 2, her body died, having been resuscitated 20 minutes after the initial heart attack and kept on a respirator for a day before being left on its own. For a week after her first "death", my father, sisters and I maintained a 24-hour-a-day vigil while we watched this shell of Setsu Suzuki, without nutrition, without medication, without any indication of "higher brain function", without any purpose, fight to live.
>
> In this terrible way, we were confronted with the painful consequences of science and technology. There was a time when the moment of death was unequivocal and simple – when the last breath was gasped or the heart stopped beating. But no longer is that true.

To David Suzuki it was far more important that his mother had lived a rich and full life to her seventy-fourth birthday than that she survived an extra week in a comatose state.

We are gradually beginning to accept the view that terminally ill patients should be permitted to die with dignity instead of being attached to life-support machines long after consciousness has faded and after any hope of recovery is gone. According to one estimate, 28 per cent of medicare funds in the United States are spent on the 6 per cent of medicare patients who die each year – i.e., four times as much is spent on patients who are dying than on other medicare patients.[18] The figures for Canada would probably be even higher, as the Canadian rate of institutionalizing the elderly is nearly double that of the United States.[19] Increasingly, questions are being asked about the quality of life that new medical technologies can offer.

There is an urgent need for a cost/benefit evaluation of surgical interventions, alternative treatments, and associated hospital costs. Certainly, accounting procedures based on diagnosis-related groupings and severity ratings would make for better information on costs. But for

more rational decision making, it would be equally important to assess the associated benefits for each DRG, each severity rating, and each age group of hospital patients. Conceptually, the procedural steps of cost/-benefit analysis are well established and go from problem definition, objective, alternative means, and possible outcomes, to associated costs, analysis of uncertainties, and ethical issues [U.S. Congress, 1980]. Any such cost/benefit evaluation would, of course, bristle with problems. In most decision-making processes only a fraction of all the potential consequences are taken into account, since the inherent complexities and uncertainties surrounding many decisions make it impossible to weigh all the conceivable consequences. Simplistic as it may be, the potential benefits could initially be quantified by the potential gain in years of human life. Other decision-making criteria could be added later.

Imagine, for example, quantifying two costly, life-saving procedures. Liver transplants are among the most costly surgical procedures. At the University of Minnesota, the average cost of a liver transplant for a child is $140,000, excluding the physicians' bills.[20] To a pediatrician it may be an immutable dictum that a sick child should receive whatever treatment is necessary, no matter what it costs. A heart transplant costs roughly $40,000. To a heart specialist it may appear that enough savings could be taken out of "everyday" medicine to make room for heart transplants. But hospital resources are not sufficient to accommodate every possible heart or liver transplant case. If a heart transplant saves, on average, five years of human life and a liver transplant more than 18 years, the trade-off would favour the liver transplant. If it added 25 years, the cost per added year would be $5,600 – lower than the $8,000 cost per year of a heart transplant. If this kind of cost/benefit analysis were systematically applied to all DRGs, appropriately stratified by severity ratings and age groups, it could yield estimates of the relation between hospital costs and years of human life saved.

A Cost/Benefit Approach to Capital Investment and New Technology

Economic theory tells us that resource inputs are transformed into output according to the laws of the production function. The theory begins with specific engineering or technological information as to how much resource input – i.e., how much labour, land, machinery and energy – is required to produce a particular good or service. The answer depends on the state of the art. If someone invents a labour-saving machine – e.g., a lithotripter, which shatters kidney stones by shock waves without surgery – that cuts hospital stays from a week to one or two days, or discovers a new method of treatment of industry-wide application – e.g., antibiotics – the output that can be obtained from the same level of resource inputs will go up.

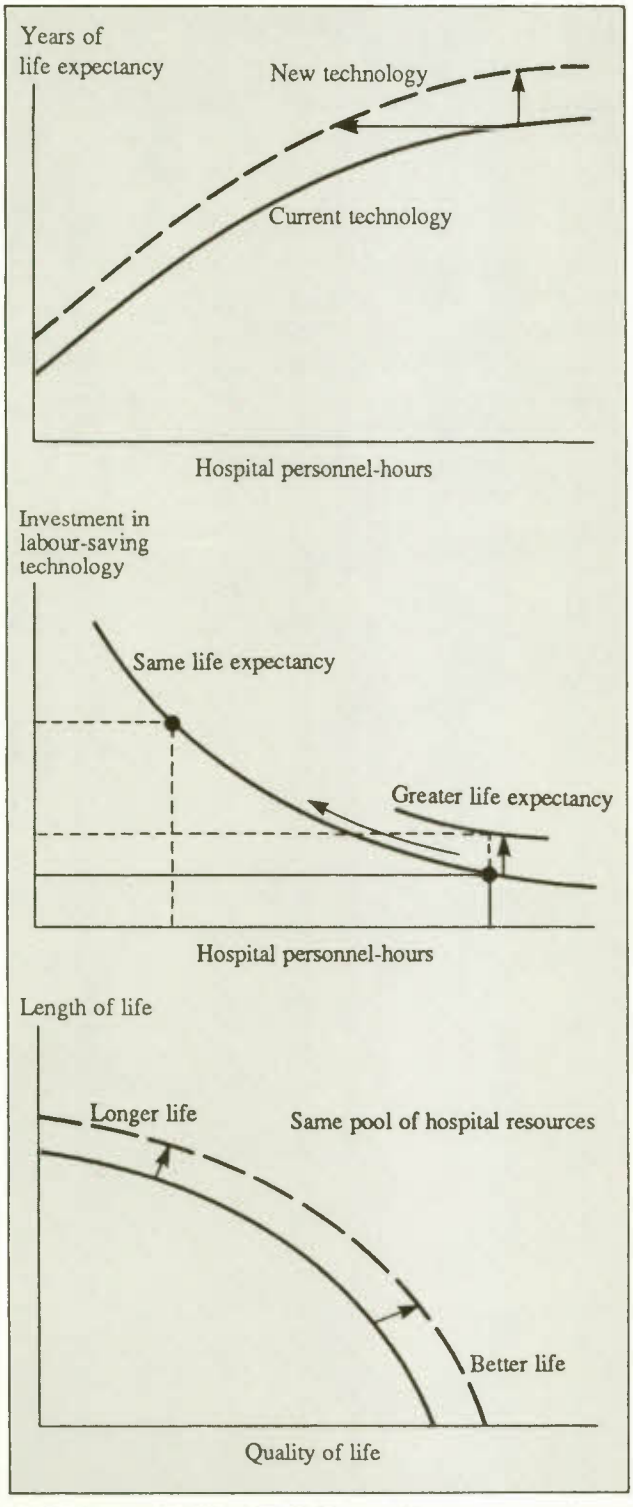
Also, economic theory tells us that when additional inputs are applied – e.g., more personnel-hours per equipment or more nursing hours per delivery in the obstetrical suite – the extra output will decline in accordance with "the law of diminishing marginal returns."[21] An optimal or least-cost combination of any two factor inputs – e.g., hours of nursing care and therapeutic equipment – is attained when the extra output of each is proportional to its respective unit cost. The same resources can be combined to yield different outputs, and their optimal combination will depend on the marginal rates of transformation of the different kinds of output and the value attached to each.

Although production function analysis is normally applied to goods-producing industries, the lack of appropriate measures of output in the service industries poses some problems. It is easy enough, however, to illustrate how the analysis applies to the hospital sector in principle. Obviously, if there were no hospital services whatsoever, the average life expectancy would be shorter. Adding only limited services would raise life expectancy, but the further addition of resources to intensive care, post-operative recovery, or coronary units would increase life expectancy less and less – hence the argument that our health services have reached "the flat part of the curve," or a plateau where extra inputs yield little or no output. To improve upon hospital productivity, new technology would need to produce greater hospital output with the same labour input, or the same output with less labour input. Since labour-saving technology is often embodied in new capital investments, that kind of change would require more capital inputs per hospital personnel. This would expand the production possibilities of the hospital sector without adding to costs (Chart 5-1).

As our analysis has shown, hospital-specific inflation and greater service intensity added more to hospital costs over the past two decades than population growth and aging combined. Most of this increase came from the wage gains of hospital personnel in excess of general inflation and from a greater number of hours required per hospital task. Our analysis has also shown that hospitals used only about one-third as much capital per worker as other industries. Judging by trends in the prices of hospital equipment and in hospital wage rates, labour-saving capital investments should have been advantageous

Chart 5-1

Potential Impact of Labour-Saving Technology on Life Expectancy, Hospital Productivity and Hospital Output, Hypothetical



for most of the past two decades. Quite likely the lack of capital investment was determined less by simple wage-rate and capital-cost differentials than by an absence of labour-saving hospital technology and a preference to invest in the latest medical technology. Taking the inflationary rise in capital costs of the late 1970s and early 1980s as a temporary aberration from the long-run trend, the development of, and investment in, labour-saving technology in hospitals should continue to be cost-effective.

Other Cost/Benefit Considerations

It is quite possible that cost containment applied to hospitals will not resolve this issue but will serve primarily to generate tension between attending physicians and cost-conscious administrators. If so, it would be better if cost-minimizing incentives were applied along production lines within hospitals, as for surgeons, surgical facilities, and hospital staff attending to the surgical suite. Methods of analysing safety, efficiency, costs and benefits are well developed in some clinical disciplines, but they are not routinely applied. There is little assurance, therefore, that new technologies with the highest ratios of benefits to costs are adopted more rapidly than others that fail this test. It would help, therefore, if new technologies were based upon a more systematic appraisal, not only of the years of life saved but of their impact on the personnel requirements and wage costs of hospitals, and on alternative uses of hospital funds.

The federal government provides major funding for health protection through disease and drug control, food research and standards, evaluation of drugs and inspection controls. But no funding is directed at the adoption and development of labour-saving technology in institutional care. The efficiency of institutional care, and specifically that of hospital care, could be improved if information on such technologies were disseminated as it becomes available in domestic and world markets. Adoption could be accelerated if the government – together with private enterprise – provided funds for further development of such technology as well as incentive payments to hospitals for experimental trial runs.

Inevitably the application of cost/benefit analysis and productivity analysis would raise other issues. Where physicians might be inclined to apply a technology when it saves a life, bioethicists would concentrate on the quality of the patient's life. At the critical margin of life and death, the decision may be clear. In 1984, the Canadian Medical Association, the Canadian Nursing Association, and the Canadian Hospital Association all endorsed a protocol under which terminally ill patients can be left

unresuscitated or allowed to die.[22] This means that hospital resources that would have prolonged a life of only biological value can instead be used to prolong a life of human value. In other situations, however, the trade-off is not so clear.

We observed, for example, that the service intensity of hospitals was far greater in Quebec than in Saskatchewan, but that access to hospitals, as measured by age-standardized admissions per capita, was much lower in Quebec. It is not self-evident which is of greater benefit – more care for fewer patients or less intensive care for more patients. Under the Canadian Hospital Insurance and Diagnostic Services Act of 1957, accessibility was one of the legal conditions to be met by the provinces. It requires "that insured services be provided in a manner that does not impede or preclude, either directly or indirectly, by charges or otherwise, reasonable access by entitled persons."[23] Underlying this condition is a value judgment that below a certain threshold level, access to hospitals is more important than service intensity. Beyond this level, however, the trade-off is not specified.

At individual hospitals, similar questions of trade-off might arise with alternatives of, say, a kidney transplant at $22,000 (including $3,000 worth of drugs annually) or daily access to a dialysis machine at $38,000 per year, or access to one hospital bed for a whole year. If funds are available for all three – i.e., transplant, dialysis, and hospital bed – there is no problem. If they are not, a decision that gives priority to one over the other is required, and this implies a trade-off between access of hospital services and service intensity. Again, at the critical margin of life and death, it may not mean life at any cost but care for someone who is dying.[24] And similarly, if a hospital bed is "blocked" by a chronically ill patient, it may mean the substitution of home care for acute care, so long as it does not imply substitution of neglect for care.

At present, it is by no means clear how cost-effectively some of the hospital services could be provided by other health care institutions. That is partly because we do not know what the cost/benefit ratios of the different services are, and partly because we do not know what the trade-offs are between prolonging life and improving the quality of life. Although a cost/benefit calculus for analysing the many possible combinations would be informative, it is doubtful that it could – or, for that matter, that it should – take the place of other decision criteria. To find answers to such questions of resource allocation, a wider range of experimentation, including private-sector involvement, could be useful, provided the experiments are conducted under "controlled" conditions.

Appendix

A List of Supplementary Appendices

A complete set of these appendices is available without charge upon request from the Information Division, Economic Council of Canada, P. O. Box 527, Ottawa, Ontario, KlP 5V6.

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Notes

CHAPTER 1

1 See Appendix Table A-1.

2 See Appendix Table A-2.

3 Based on Health and Welfare Canada. *National Health Expenditures in Canada, 1984*, p. 8; and preliminary estimates by verbal communication.

4 See Organisation for Economic Co-operation and Development, 1984, p. 6 and Table 5.

5 See "Health care international," in *The Economist,* April 28, 1984, pp. 17-35.

6 See Menzel, 1983, and the article by Herbert Stein, former chairman of the U.S. Council of Economic Advisors, entitled "Price of health," in *Fortune*, October 31, 1983, pp. 203 ff.

7 The principal goals of Canada's health insurance program identified in the Hall Report are:
– portability to ensure those citizens of one province who take ill or need medical or hospital services in another province a certain uniformity of benefits and coverage;
– comprehensiveness, to ensure citizens a complete line of health services – i.e., preventive, diagnostic, curative, and rehabilitative services;
– accessibility, to ensure citizens, irrespective of economic or other considerations, reasonable access to insured services;
– universality, to ensure citizens universal and uniform coverage, regardless of age, state of health, or income; and
– public administration, to ensure that the insurance is administered on a non-profit basis under strict government supervision.
Details of the principles underlying Canada's health insurance are described in M.Trahan, 1981, pp. 209-49.

CHAPTER 2

1 Expenditures on institutional care amounted to $0.95 billion in 1960 and to $16.59 billion in 1982. See Health and Welfare Canada, 1979 and 1984, pp. 92 and 32, respectively.

2 Estimation procedures are described in Appendix B under the heading "Hospital costs, population growth, and per capita costs."

3 Estimation procedures are described in Appendix B under the heading "Changes in age distribution and hospital admissions per capita."

4 In an analysis of hospital expenditures in Canada it was found that for every 1.0 per cent population growth, hospital expenditures increased by 1.5 to 2.0 per cent; a difference that was attributed primarily to aging of the population [Angus, 1983].

Professor R. G. Evans, in a paper prepared for the British Consumer Health Fund Forum on the Health Care of the Aged in 1983, observes: "Within a 50-year time horizon, the impact of aging on costs is relatively small compared to the increases in costs over the last quarter century. If death rates keep falling, *eventually* the cost increases may become severe. But eventually may be generations away.

What *is* happening is that patterns of care for the elderly are shifting in response to changes in technology and in the manpower and other resources in the health care system itself. Age-sex specific rates of utilization are rising faster for the elderly than for the general population. The "cost problem" is not that there are more elderly – though there are – but that the health care system is responding more intensively to what it defines as their "needs." The problem is in the health care system itself, not in external demographic forces...." (pp. 1-2).

5 The cost of each depends on the number of hours of attending personnel, their hourly wage rates, and the quantities and prices of supplies. In 1979/80, for example, delivery of a baby in the obstetrical suite required 21 nursing hours, at an hourly wage rate of $9.42 (including fringe benefits), and medical and surgical supplies of $18.34. Care of a baby in the nursery required 5.5 nursing hours per day, at an hourly wage rate of $9.00, and supplies of $11.87. Care of a regular inpatient required 5.5 nursing hours per day at an hourly wage rate of $8.61, and supplies of $4.61.

Although a wage or price change in one hospital department is quite separate from that of another department in accounting, the two are not totally independent in practice. Just as wage and price inflation of one sector of the economy spreads to another, cost increases in one hospital department will likely affect others.

6 Estimation procedures are described in Appendix B under the heading "Hospital costs per inpatient admission."

7 Estimation procedures are described in Appendix B under the heading "Hospital costs per inpatient admission."

8 Since the same outpatient may visit several outpatient units – e.g., radiology, emergency, and therapeutic services – the number of visits does not necessarily match the number of outpatients. It is not possible, therefore, to compare the effectiveness of outpatient services with that of inpatient services. Estimation procedures for the cost analysis of outpatient services are analogous to those of inpatient services, as described in Appendix B.

9 According to P. Victor, the output-accounting approach was introduced by the Institute of Medicine to emphasize that health costs consist not only of direct expenditures on health services but also of lost earnings, valued at the wage rate or earnings level of the individual or a given distribution of income and wealth. Applied to individuals exposed to the same morbidity and identical treatment, the output accounting measure will vary from one to the next as wage rates or earnings differ between them. The measure is not additive because the "gaps" left by high-wage or high-income earners can always be filled by the next-in-line lower-income earners, and ultimately the loss to society may be no higher than that of the marginal income earner at the low end of the scale. Applied to different groups of individuals – e.g., provincial populations characterized by the same morbidity distribution and identical treatment but by different income levels and distributions – the output accounting measure will vary from one group to the next as average and marginal incomes differ between them. Technical details of the accounting approach are described in Victor, 1985.

10 Among industrial countries, the life expectancy of Canadians ranks about average. As in other countries, improvements in life expectancy have come from a variety of factors. Results of a statistical analysis relating health care services to life expectancy are described in Appendix B under the heading "International comparison of life expectancy."

11 The adjustment procedure for age effects is described in Appendix B under the heading "Age distribution, length of stay, and hospital output." The adjustment procedure for age effects and morbidity treatment is described in Appendix B under the heading "Age distribution, morbidity mix, length of stay, and hospital output."

12 The technique of production function analysis, as applied here to the hospital sector is described in Appendix B under the heading "Production function analysis."

13 The underlying conditions are described in a more formal manner in Appendix B under the heading "Production function analysis."

CHAPTER 3

1 See Statistics Canada, 1979; and Statistics Canada, 1983, pp. 24 and 54.

2 Such a strictly proportionate change in per capita hospital expenditures in response to changes in either hospital admission rates or costs per admission will occur if, and only if, no other changes occur concurrently. It has been observed that a 1 per cent rate of growth in Canada's population has historically been associated with a growth rate of 1.5 to 2.0 per cent of hospital expenditures. This additional growth has at times been attributed to changes in demographic factors [Angus, 1982] and will be considered separately here.

3 Details are given in Appendix Table C-23.

4 Although it is a common perception that the dollar cost per patient stay varies with the length of stay, analysis of hospital expenditures is generally based on more refined procedures. In a recent study of hospital expenditures in Canada, for example, costs were estimated for various types of hospitals to capture variations in costs per patient-day: "Per diem hospital costs at the provincial level assign equivalent weights to each day of care in each province. As such, they do not allow for a distinction among various diagnoses nor for varying treatment costs for a given diagnosis from one hospital to the next. Consequently, it was decided to use the hospital-specific per diem costs. While this process permits the per diem rate of hospital expenditures to more realistically reflect varying institutional scenarios, e.g., active treatment hospitals have higher per diem rates than extended care institutions, thus giving some degree of improvement over the province-wide measures, it does not address the potential reasons for these cost differentials nor does it facilitate costs to be deduced from a disease-costing perspective. Since our data do not render linkage to obtain these hospital-specific inpatient operating expenditures which would reflect diagnostic variability, we have to rely on the method outlined above to allocate gross hospital-specific costs by major diagnostic classification, and the assumption that all days of care in a given hospital cost the same." [Angus and Lefebvre, 1982, p. 13.]

The authors elaborated further on this point in a footnote:

..."It would be ideal to have inpatient hospital-specific costs assigned to diagnoses which generated these expenditures. It is not realistic to assume that costs would be identical for two patients admitted to different hospitals for similar conditions, nor to assume that two patients selected at random from the same hospital for the same length of time would have the same costs.

While this assumption has been made in Fraser, and Spasoff, *An Estimate of the Economic Burden of Ill-Health,* Ontario Council of Health, Toronto, 1976, and other studies, it does not conform with conventional wisdom in the area of hospital costs. Specific disease costing studies, e.g., Colin Lay's thesis, *Disease Costing in an Ambulatory Clinic: Disease and*

Physician Profiles and the Selection of Patients for Review, M.I.T., 1978, have indicated that the early days of care are far more expensive than the later days of a stay. As well, Evans and Walker, 1972, "Information theory and the analysis of hospital cost structure," *Canadian Journal of Economics* 5, pp. 398-418 have shown that the considerable variation in case-mix between hospitals is a significant determinant of interhospital differences in cost per day and cost per case, as are the age and sex patterns of discharge."

5 Inpatient equivalents are the sum of hospital inpatients and outpatients with the latter converted into equivalents of the former, on the basis of the annual cost ratios of outpatient visits to inpatient stays. More "liberal" estimates of the total volume of hospital patients are provided in the final section of this chapter. The various measures used were described earlier in Chapter 2.

6 This research is being conducted by Dr. E. Nicholls of the Non-Communicable Disease Division of the Bureau of Epidemiology, Health and Welfare Canada.

7 Related data are given in Appendix Table C-25.

8 See Appendix Tables C-1 to C-22.

CHAPTER 4

1 The Right Honourable Pierre Elliott Trudeau, "Opening remarks of the Prime Minister to the federal-provincial conference of first ministers," Document FP-8-018, Office of the Prime Minister, Ottawa (Press Release, June 14, 1976).

2 Alberta is the only exception. Alberta's per capita expenditures were close to the national average (only 2.0 per cent away from it), and over the past two decades, all of that deviation could be attributed to lower per capita outpatient expenditures (Table 4-1).

3 See Appendix Table D-1.

4 See Evans, 1984, pp. 202-203.

5 See Appendix Tables D-2 to D-5.

6 See Appendix Table D-6.

7 See Appendix Table D-7.

8 The long-term disparities between provincial wage rates are illustrated in Auer, 1979, Chart 3-1, p. 48.

9 See Appendix Tables D-2, D-3, D-4, D-5 and D-7.

10 A more detailed definition of service intensity is given under "Intensity of hospital services" in Chapter 2. Technical definitions appear under "Service intensity" in Appendix B.

11 In this case the combination of service intensity and admission rates would be measured by the total contribution of intensity and rates to provincial differences in per capita hospital operating expenditures, as shown in the first column of Table 4-4.

12 This point is made, for example, by Fuchs, 1972, Chapter 4.

13 As shown in Table 4-7, hospital output per worker, defined in terms of the number of patient stays per person-year, ranged, on average, from a high of 43 per cent above the national average in Newfoundland to a low of -18 per cent in Quebec. Adjustment for variations in factor inputs left this range about the same – from 44 to -18 per cent, respectively.

14 See Appendix Table D-11.

CHAPTER 5

1 *The Wall Street Journal*, "Senator sees smooth passage of proposal limiting medicare payments to hospitals," February 3, 1983, p. 6.

2 *Business Week*, "Medicare costs go under the knife," April 11, 1983, p. 31.

3 It was anticipated that there would be 18 different prices for each diagnosis, since the system allows for each of nine different regions and for urban and rural areas within each of them (as reported in *The Economist*, April 16, 1983, p. 45).

4 *The Wall Street Journal*, "Medicare plan sails through a house panel, bill to hold down payments now goes to full ways and means," by Robert W. Merry, February 25, 1983, p. 4.

5 See Stoughton, 1983. Supporting evidence comes from Dr. Susan Horn's work at the Center for Hospital Finance and Management, Johns Hopkins Medical Institutions, Baltimore, Maryland.

Under the conventional method of assessing case-mix complexity, all hospital patients in the same DRG category are rated at the same cost. When, in addition, they are assessed for severity of the disease, they are rated at different costs. Under this more refined system of assessment, patients with similar medical conditions are rated according to different stages of the disease – such as disease with no complications and minimal severity, disease with local complications and moderate severity, disease with systematic complications and serious problems, and patients with terminal or final-stage disease – and in each case the DRG cost index is modified accordingly. It has been demonstrated that DRG ratings, adjusted for severity of the disease, explain cost variations among hospitals better than the conventional ratings of case-mix complexity. After allowing for severity of illness, the

costs of academic teaching hospitals, for example, were found to be similar to those of regular community hospitals.

6 *Business Week*, "The spiraling costs of health care Rx: Competition," February 8, 1982.

7 Based on Kaufmann and Verwey, 1984.

8 The dividing lines between HMOs and PPOs are becoming more blurred as a result of increasing competition between the two. There are now several types of HMOs. Some deliver services through their own staff; others contract it out to individual practice associations or IPAs. Other HMOs contract with two or more group practices. Hence HMO members are gaining access to a wider range of choices.

9 Conclusion based on a study by Barer, 1981.

10 See Thomas Moore, "Promising industries for investors," in *Fortune, Special Issue: The 1986 Investor's Guide* 112, No. 10 (Fall 1985):88-92.

11 See William B. Schwartz, "The most painful prescription," in *Newsweek*, November 12, 1984, p. 24.

12 See W. John Wilson, "Hospital chains struggle to stay in the pink," in *Business Week*, March 22, 1985, p. 258.

13 See *The Economist*, "Profitable American hospitals," May 18, 1985, pp. 82-83.

14 See Michael Waldholz, "Report on hospitals says high charges, extra services help chains make money," in *The Wall Street Journal*, August 11, 1983, p. 5.

15 R. Victor Fuchs, "Another health-care changeover – At what cost?" in *The Wall Street Journal*, June 28, 1985.

16 "Operate on costs, not on every patient," in *TODAY*, October 31, 1983.

17 David Suzuki, "Science and death – Changing the simple dignity," in *Science Dimension* 16, No. 4 (1984):30.

18 Richard Lamm, "Long time dying," in the *New Republic*, August 27, 1984, pp. 20-23.

19 According to the Task Force on the Allocation of Health Care Resources, the rate of institutionalization of the elderly in Canada in 1981 was 9.4 per cent, compared with 5.3 per cent in the United States, and the percentage of the elderly population (65-74 years of age) in public, general and allied special hospitals was 1.4 per cent while that of the very elderly (75 and over) was 4.0 per cent. See Task Force, 1984.

20 David Wessel, "Transplants increase, and so do disputes over who pays bills," in *The Wall Street Journal* CCIII, No. 72, April 12, 1984:1-24.

21 By the law of diminishing return, the marginal product of extra output added by an extra unit of a factor input will eventually decline as more and more units are added. In the goods-producing industries the extra output would be measured in terms of physical product – e.g., bushels of corn per unit of fertilizer added – and the decision to add more inputs would depend on its unit cost and the dollar value of the extra output – e.g., the cost per bag of fertilizer and the dollar value of the additional yield of corn. Analogously, in the hospital sector the extra output could be measured in terms of years added to the patient's life span, and the decision to provide additional hospital services would depend on the unit cost of the extra resource input – e.g., nursing hours, materials and supplies, and the dollar value of the patient's longer life span (a value of contentious magnitude).

22 Ian Brown, "Doctor's dilemmas," in *The Globe and Mail*, April 20, 1985.

23 See Parliamentary Task Force on Federal-Provincial Fiscal Arrangements, 1981, p. 105.

24 This "bioethical solution" was attributed by Ian Brown to George Webster, who provides ethics programs at three Toronto hospitals.

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