Health Care Technology in Canada

(with special reference to Quebec)

by Renaldo N. Battista, Robert Jacob, Matthew S. Hedge

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OVERVIEW OF CANADA

Canada is a sparsely populated northern landmass of approximately 10 million km^2. Created in 1867 after French and then British colonization, the Canadian federation currently consists of 10 provinces and two territories. Provincial populations in 1991 (table 3-1) make apparent the rather imbalance distribution of Canadians across the country (119). Compounding this imbalance is the population's north-south distribution; 80 percent of Canadians are clustered within 320 km of the border with the United States. Providing services to the remaining 20 percent living in remote areas has been a key issue throughout Canada's development.

Despite the logic of north-south transport links between Canadian regions and adjacent regions of the United States, domestic east-west links have been heavily emphasized. This historical pattern arose from the central location of the four founding provinces—Ontario, Quebec, New Brunswick, and Nova Scotia—combined with a mistrust of their southern neighbor, the United States, in the aftermath of the U.S. Civil War and apparent territorial designs on what was, until 1867, British North America. East-west links also clearly benefited English mercantilist trade during the 1800s. Recent free-trade agreements between Canada and the United States as well as among Canada, the United States, and Mexico suggest that Canada now wishes to consolidate and expand its north-south links.

Government and Political Structure

In light of the strong ties, both economic and historical, to Great Britain, it is not surprising that until 1982, Canada's constitution consisted of the British North America (BNA) Act of 1867 and

TABLE 3-1: Provincial Populations, 1991

Province	Year joining confederation	Population (1991)
Newfoundland	1949	**568,475**
Prince Edward Island	1873	**129,765**
Nova Scotia	1867	**899,945**
New Brunswick	1867	**723,900**
Quebec	1867	**6,895,960**
Ontario	1867	10,084,885
Manitoba	1870	1,091,940
Saskatchewan	1905	988,930
Alberta	1905	2,545,550
British Columbia	1871	$282,065
CANADA	(excluding Yukon and Northwest Territories)	27,211,415

SOURCE Statistics Canada, The *Nation Age, Sex, and Marital Status,* Statistlcs Canada Pub No 93-310 (Ottawa 1993)

subsequent amendments. This act of the British parliament established governmental structures and jurisdictional divisions between federal and provincial governments, and amendments required the assent of the House of Commons in England. Despite the distance between the BNA Act and the people it governed, this process worked reasonably well.

In 1982, however, the Constitution Act was passed by the Canadian parliament, effectively repatriating the BNA Act and enshrining a Canadian Charter of Rights and Freedoms in a new Canadian constitution. Repatriation was supported by all provinces but Quebec. To gather sufficient support for repatriation from the other nine provincial governments, the federal government provided a "notwithstanding clause" allowing provincial governments to pursue legislative goals that might impinge on the guarantees of the Charter of Rights and Freedoms.

Canada's federal legislature is a bicameral parliamentary system with 295 Members elected to the House of Commons and 104 Senators appointed by the Prime Minister for terms until age 75. Legislative power resides almost entirely in the House of Commons; the Senate only rarely intervenes to reject legislation. Executive power resides in the cabinet, which is composed of the prime minister and ministers—nearly all of whom are also members of the legislative branch by virtue of their being elected to the House of Commons.

The provincial legislatures operate in a similar fashion but without provincial equivalents of the Senate. Three essentially national political parties are active in both federal and provincial politics. The Progressive Conservative Party espouses a right-leaning, centrist philosophy, and the Liberal Party advocates a more clearly centrist philosophy. The New Democratic Party (NDP) has traditional links to organized labor but is most similar to the centrist social democratic parties found in several European countries. The NDP has been the source of virtually all major social policy initiatives in Canada, particularly in health care. During the 1960s the federal Liberal Party established the Medicare system of national health insurance along the lines established by the NDP in Saskatchewan and in NDP position papers.

Jurisdictional tension between federal and provincial governments has encouraged the growth of several parties with peculiarly regional support and agendas generally stressing more autonomy for their region. In the western provinces these have been particularly strong, often also advancing a conservative social agenda. In addition, the *Parti Que'be'cois* in the predominantly French-

speaking province of Quebec has advocated various measures that would markedly diminish federal jurisdiction there.

Issues of language and ethnicity are a staple of Canadian political life. Both English and French are considered official languages, and federal services are ostensibly available in both languages across the country. Roughly 24 percent of Canadians state that French is their first language, and of these, 88 percent live in Quebec (118). Treaties signed with aboriginal peoples have created "status" Amerindians, who constitute approximately 2 percent of the population.

Population Characteristics

Apart from the small aboriginal population, Canadais a country of recent immigrants, initially from northern Europe and the British Isles but (after World War II) increasing y from other parts of Europe and Asia. According to the 1991 census, 19 percent of Canadians were born outside Canada (11 7). The federal government has adopted an official policy of multiculturalism, encouraging recently arrived Canadians to maintain features of their places and cultures of origin. Immigrants to Canada have tended overwhelmingly to settle in Canada's three largest cities: Vancouver, Toronto, and Montreal.

The Economy

In addition to ethnic and language differences among regions, important regional economic differences exist. British Columbia, Alberta, Ontario, and Quebec account for 84 percent of the population and have traditionally been seen as the "have" provinces. Their economies are the most diversified and integrated with North American and world markets. The four Atlantic provinces, by virtue of their small size, remote location, and dependence on fishing and lumbering are the weaker siblings in the Canadian family.

The central prairie provinces, the birthplace of many of Canada's social welfare programs, are heavily dependent on agriculture and resource extraction. With Canada's national capital located in Ottawa and the financial capital in Toronto, Ontario has often been perceived, particularly by provinces more distant from central Canada as having a stranglehold on power in Canadian society. This perception, accentuated by the relatively large populations of Ontario and Quebec, has spurred repeated attempts to recast Canadian political institutions, particularly the Senate, along regional or provincial lines.

Background on Quebec

Because much of the data for this chapter are drawn from the province of Quebec, a few words on its history are in order. Originally colonized as New France by French farmers, fishermen, and fur traders, Quebec was lost to the British in 1759 at the Battle of the Plains of Abraham. Despite several halfhearted attempts to assimilate the French into an emerging English society, the British were seemingly content to govern a colony with a predominantly English-speaking, Protestant urban center and a French-speaking, Catholic countryside. The Roman Catholic church controlled many of the social structures, including health care and education, and encouraged the embrace of a simple, pastoral life.

As pressure for change built during the late nineteenth and early twentieth centuries, this fundamental linguistic and geographical division remained intact, despite rapidly increasing francophone urbanization. By the middle of the twentieth century, forces of social change had ushered in secular social services and public education in both English and French and had supplanted the power of both the Catholic church and English-speaking business elites in the province. This "quiet revolution" represented a wholesale transfer of power and influence from these former pillars to a newly dynamic provincial government and an array of secular nongovernmental bodies.

Concomitantly, historical expressions of concern about the future of Quebec in Canada and of the desirability of independence resurfaced with broader support. In 1980 the ruling *Parti Que'be' cois* lost a referendum seeking a mandate to negotiate some form of "sovereignty-association" with the rest of Canada. Since that time, popular

support in Quebec for sovereignty has remained at approximately 30 to 45 percent of poll respondents. In keeping with a desire for increased autonomy, Quebec chose not to consent to the Constitution Act of 1982. The decade since then has seen the failure of two major, federally initiated constitutional proposals designed in part to satisfy Quebec's agenda. Neither has received sufficient support from the constitutionally required combination of provinces and population.

HEALTH STATUS OF THE POPULATION

The health of Canadians has improved immensely throughout the twentieth century; life expectancy is now 81 years for women and 74 years for men (126). Reflecting a general pattern among Organization for Economic Cooperation and Development (OECD) countries, ischemic heart disease and cancer are the two main causes of death. Tobacco appears to be a major contributor to these tolls, despite heavy taxation of tobacco products.

Among Canadian men, ischemic heart disease accounts for 24 percent of deaths, and lung cancer for 9 percent (1990 figures) (114). Among Canadian women, ischemic heart disease accounts for 22 percent of deaths, followed by breast cancer (5 percent) and lung cancer (5 percent). Motor vehicle accidents account for 3 percent of male deaths and 1 percent of female deaths, with much larger percentages among young men.

The Canadian population continues to grow from both immigration and natural increase. In 1990 the birth rate was 15 per 1,000 population and the rate of natural increase was 8 per 1,000. Birth rates are highest in the Atlantic provinces. Infant mortality was 6.8 per 1,000 live births, of which 68 percent occurred in the first month (neonatal mortality) (11 6). These rates were highest in Newfoundland and the Northwest Territories, the parts of the country with lowest average incomes. Circulatory anomalies were the largest single cause of infant deaths (14.3 percent of female deaths and 11.8 percent of male deaths). Obstetrical complications accounted for about 10 percent of infant deaths (115).

Data on overall morbidity are not routinely gathered; however, accurate data are available on hospital use. Overall rates of use (excluding pregnancy-related admissions) indicate that men and women are equal users with a national rateof117 admissions per 1,000 population in 1990. For men the three greatest causes of hospitalization were diseases of the circulatory system (18.4 per 1,000), gastrointestinal conditions (16.1 per 1,000), and respiratory disease (15.7 per 1,000). Pregnancy and related care was the main reason for female admissions to hospitals (40.7 per 1,000), followed by gastrointestinal conditions (15.1 per 1,000) and diseases of the circulatory system (14. 1 per 1,000) (1 14). In general, lengths of stay have decreased throughout the last decade, although a growing proportion of beds in acute care hospitals are occupied by long-term residents, in part because of increasing numbers of very old people.

THE CANADIAN HEALTH CARE SYSTEM

Under the Canadian constitution, health care is a provincial responsibility; the federal role is limited to health care financing, health protection, and environmental health. Although all Canadians are insured for health services, 13 different health care systems exist, one in each of the provinces and territories and a federally managed one for aboriginal peoples.

The current system of universal health insurance grew from concerns at both federal and provincial levels that insurance, particularly for hospital services, was needed to improve the lives of Canadians. In the aftermath of the Second World War, a federally subsidized program was offered to the provinces in return for their ceding the collection of personal and corporate income taxes to the federal government. Not surprisingly, the provinces rejected this plan. Nonetheless, high public expectations led to the creation of provincially administered plans in several western provinces and the growth of private sector Blue Cross/Blue Shield plans in several other provinces. Wrangling continued until 1956, when the

two levels of government agreed to a financing scheme based on equal federal and provincial shares. By 1958 a federally subsidized, provincially administered program of hospital insurance was in place.

This program, coupled with public pressure, led the government of Saskatchewan to establish a program of comprehensive, publicly funded medical insurance in 1961. Physician-sponsored insurance carriers, alarmed at the support for and success of government-managed insurance, were instrumental in the 1961 federal decision to form the Royal Commission on Health Services, directed to address the issue of national health insurance (3, 122).

The Commission's report, released in 1964, called for a federally subsidized, provincially administered system of comprehensive medical insurance. The newly elected federal Liberal administration, having campaigned on a promise to establish a national health insurance system, provided a receptive policy environment. Canada's comprehensive Medicare system was thus created, with federal contributions conditioned on four criteria: services were to be comprehensive, benefits were to be universally available, coverage was to be portable from province to province, and the system of insurance was to be publicly administered (66). Despite some initial resistance from physicians, including job actions in several provinces, all provinces had joined the scheme by January 1, 1971. Since then, support for national health insurance has remained high among both physicians and the public.

Recently, several provinces have reviewed their health care systems comprehensively. These reviews include the Commission d'enquete sur les services de Sante' et les Services Sociaux in Quebec, and groups in Ontario and British Columbia (56, 102, 106). All of these have been generally oriented to prevention and regionalization and, more recently, to quality assurance, technology assessment, and cost control. The multiplicity of planning reports underscores the fact that each province designs its own approach consistent with the goals and conditions for federal financing. Although all provinces need to slow the growth of expenditures, the controls in place and available policy options differ among them.

Despite provincial variation, Canada's current health care system represents a balance among government direction, consumer choice, and provider autonomy. Universal health insurance, administered by provincial governments on a shared-cost basis with the federal government, covers inpatient and outpatient care in hospitals, ambulatory care and, in some provinces, prescribed medications and appliances. All provinces also provide some coverage for long-term care. Hospitals are autonomous corporate bodies administered by boards of directors. Patients are free to consult the physician of their choice as often as they desire. Physicians are reimbursed on a fee-for-service basis, with fee schedules determined by negotiations between provincial medical associations and ministries of health. When the system was first introduced, physician incomes increased from the levels of the pre- insurance era.

Over the last decade, federal health care financing has fallen in real terms, and several provincial governments have considered introducing copayments, deductibles, or other revenue sources that might simultaneously limit the demand for services. Provincial options are, however, limited by provisions of the Canada Health Act. Promulgated in 1984, this federal legislation sought to reaffirm the principle of universality by banning user fees and "extra billing" by which physicians would charge patients directly for services at rates higher than those of the fee schedules negotiated between medical associations and governments (71). The bill received broad public support but was viewed by several provinces as unwarranted federal interference in a clearly provincial jurisdiction.

In spring 1993, candidates for the leadership of the federal Progressive Conservative Party stated publicly that user fees may have a place in the Canadian health care system. It remains to be seen how provinces will respond to increasing health care expenditures in light of decreasing federal contributions coupled with the revenue restrictions mandated by the Canada Health Act. Despite increasingly fragile fiscal health, provincial gov-

emments have shown little interest in moving away from a single-payer system.

In addition to the administrative efficiency of having one payer for all services, the provincial governments exercise a fair degree of control over facilities construction and technology diffusion. Hospitals generally receive an annual, prospective global budget to cover operating expenses, and some provincial health ministries administer separate capital budgets for facilities construction and equipment. This centralized resource allocation scheme, coupled with a degree of power to determine which services in which locations will be deemed reimbursable, has led to less technology uptake than in the United States (24,107).

Control over physician numbers has been rather more problematic. Primary care physicians and specialists are approximately equal in number, but the total numbers of both are perceived in some quarters to be excessive. During the 1960s overly generous predictions of the growth rate in Canada's population and in the number of doctors who would leave Canada after Medicare was introduced led to an increase in the number of places in Canada's 16 medical schools. A generation later, provincial governments are trying various schemes to limit the number of practicing physicians and, more directly, expenditures for physician services. Recognizing the need for national coordination, the Conference of Deputy Ministers of Health commissioned a report to examine the state of medical personnel in Canada. The report made a number of recommendations that, in the absence of a national framework for action, have been variably adopted by provincial governments (10).

Despite an increase in the number of physicians per capita, a geographic maldistribution has persisted, leaving urban areas overstaffed and rural areas understaffed. In the province of Nova Scotia, for example, roughly 900 of the province's 2,000 physicians practice in the Halifax-Dartmouth area, home to 36 percent of the population.

The provinces have developed a variety of policies to address maldistribution and contain the cost of physicians' services. Quebec appears to have been the most effective, establishing caps on gross revenues for family physicians and specialists. Accompanying these caps is a fee differential such that recently qualified physicians practicing in one of the province's three urban areas receive only 70 percent of the mandated fees, whereas those in underserved areas receive 115 percent if they are family physicians and 120 percent if specialists. British Columbia, the province with the most physicians per capita, sought to limit the number in the Vancouver area by tying new billing numbers to specific locations outside Vancouver. The courts, however, deemed this restriction an unconstitutional limit of rights to mobility.

Perhaps mindful of the experience in British Columbia, in 1993 Ontario announced that family physicians, pediatricians, and psychiatrists establishing practices in all but a few locations designated as underserviced would receive only 75 percent of mandated fees. This plan appears to be an attempt to circumvent legal challenges based on limitations to mobility rights while not explicitly invoking the "notwithstanding" clause of the Canadian constitution. This clause has not yet been used to address physician distribution but may become increasingly attractive as provincial governments perceive that physicians are maldistributed and a cause of rising health care expenditures.

Given the particular reference to Quebec in this chapter, two features of that province's health care system deserve mention. The first is the integration of health and social services, which are managed by single bodies at the provincial and regional levels. Quebec has established a province-wide network of *Centres Locaux de Services Communautaires* (CLSCs), intended to be the front-line point of service. CLSCS have been most successful in rural areas but less so in urban areas, where they face competition from physicians in private offices.

The second distinctive feature of Quebec's system is regionalization. The province is divided into 18 administrative regions, each under a regional authority, the *Re'gie Re'gionale de la Sante' et des Services Sociaux* (RRSSS). Although these RRSSSS have been involved for some years in management of the health system and particularly,

responsible for a portion of the budgets for technology acquisition, their role has been greatly enhanced by recent reforms giving them broad powers over planning and organization of services and the allocation of resources.

One final point is the importance of the frame of reference from which one examines the Canadian health care system. The United States, by virtue of its size and power and its proximity to Canada (both geographically and culturally), looms large as a standard of comparison in any examination of the Canadian way of doing things. From this vantage point, Canada appears to be doing everything right, spending 30 percent less per capita on health care than the United States and having better experience in both infant mortality and life expectancy (108). However, a more global view reveals that Canada spends more per capita on health care than any other country in the world except the United States. In 1989 Canadian per capita spending was 36 percent higher than that of Germany and more than double that of the United Kingdom (108). From this point of view, Canadian decisionmakers are increasingly concerned about the future health of Canada's health care system and are turning for help to a number of tools, including technology assessment.

CONTROLLING HEALTH CARE TECHNOLOGY

Macro-Mechanisms for Fiscal Management

In Canada the diffusion of health care technology is determined largely by the health care system's overall structure. Factors promoting or limiting the system's expansion have significant effects on technology diffusion. Among these structural factors, autonomy of both hospitals and physicians is the main force favoring technology acquisition and use. Fee-for-service remuneration, making the physician a quasi-entrepreneur in a publicly funded system, often creates incentives for practitioners to adopt and use technology. Hospitals' pursuit of institutional development and physicians" pursuit of professional development combine to favor the rapid uptake and diffusion of innovative health care technologies.

Countering these expansive forces are several funding and management mechanisms, the most important of which is the global budget formula used to fund hospitals. Under this system hospitals are provided with annual budgets for the basket of services they provide. Hospitals retain a fair degree of latitude in choosing which services they will offer, but they must address specified health needs.

By limiting the resources available for hospital services, the global budget constrains the ability of hospitals both to acquire expensive technologies and to expand services. This restriction applies not only to inpatient services but also to a large number of outpatient services, such as laboratory tests and radiological examinations, most of which are dispensed by hospitals. Global budgeting at the hospital level thus offsets the expansive incentives of fee-for-service remuneration of physicians. In several provinces, incentives for technology use are further tempered by measures to cap physician billings.

Rules governing the management and financing of capital expenditures constrain hospital autonomy in developing new services, particularly those requiring expensive technological innovations. In Quebec, hospital capital budgets are separate from operating budgets, and depreciation is not a recognized component of the global budget. Because institutions have limited internal funds for financing capital spending, they must obtain subsidies from regional authorities or the provincial government for all but small projects. Even if a hospital manages to obtain private donations to finance some of its capital projects, authorization by regional authorities or provincial governments is still required by law in most cases. Thus, regional and provincial planning and financing act to restrain the development of new services.

Public funding and management of medical and hospital services with the provincial government as sole payer for health services is the key factor in modulating the forces and incentives that determine technology diffusion and use (47). By

collectivizing health care financing through taxation and subsequent public funding, the public has both a right to health care services and an obligation to assume the burden of their costs through taxation. Regulation seeks to balance the citizen as taxpayer and as health care consumer. Government, both as the overall manager of the health care system and as a body of elected representatives, must try to minimize the tension between these two perspectives.

Recent Policy Reports and Decisions

Given minimal federal jurisdiction over the health care system, national policy reports or decisions are limited to particular, generally narrow issues. Throughout the 1980s, attempts to establish a national technology assessment council or body ran aground on the shoals of provincial discomfort with what were perceived to be federal incursions into perhaps their most critical area of jurisdiction. As a result, national-level policy, data, and reports on technology have generally appeared sporadically and have had minimal impact. In 1993 the newly elected Liberal government promised a national inquiry into Canada's health system with a view to identifying opportunities for reform.

In Quebec the Commission of Inquiry on Health and Social Services reviewed the health care system from 1985 to 1988 (56). The commission's report led in December 1990 to a complete overhaul of legislation governing health and social services, redefining the system's organizational and functional features (69). Despite strong protests from the medical profession, the new legislation was enacted in the fall of 1991 with slight modifications.

With regard to health care technologies, the Commission identified three major problems: obsolescent equipment and a technological lag, haphazard diffusion of certain technologies, and a need for technology assessment. Addressing obsolescent equipment and the technological lag, the Commission noted that the lag perceived in relation to the United States vanished when European countries were compared with Quebec. Haphazard technology diffusion occurred when diffusion did not follow the priorities dictated by hospital size and expertise—for instance, when a region's first magnetic resonance imaging (MRI) device was placed in a hospital other than the one responsible for neurological and neurosurgical services. Regarding the effectiveness and efficiency of health care technologies, the Commission called attention to the frequent lack of solid data that could guide decisionmaking.

In response to perceived technological lags, the annual investment in new technologies was increased (from $15 to $25 million a year).] To rationalize the diffusion of expensive and sophisticated technologies, increased powers were granted to the Minister of Health and Social Services to control the organization and deployment of highly specialized services. Two additional steps were recommended: 1) adding health care technology assessment to teaching, research, and dispensing of specialized services as a mission of Quebec's university hospitals and institutes, and 2) establishing a body to assess health care technologies for Quebec. The government created the *Conseild' evaluation des Technologies de la Sante'* (CETS) a few weeks before the Commission's report was published.

Research Policy

Canada has historically ranked near the bottom of the OECD countries in terms of per capita government spending on research (74). Both federal and provincial governments support various types of research through funding councils responding primarily to investigator-initiated proposals as well as through other programs of more directed funding.

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1 All dollar figures are given in current canadian dollars. The value of the Canadian dollar against other currenices has fluctuated but has generally been in the range of $1 CAN = $0.74 U.S. to $0.82 U.S. over the last decade.

Most government spending on health-related research is through the Medical Research Council (MRC) annual budget of approximately $250 million. Most of this amount funds laboratory-based basic science research, although the MRC recently unveiled a strategic plan calling for greater efforts in health services research. Currently, most government-funded research relevant to technology assessment and health policy is supported by the federal National Health Research and Development Program (NHRDP) and provincial funding bodies in Alberta, British Columbia, Manitoba, Ontario, Quebec, and Saskatchewan.

Measuring the actual amounts spent on such research is difficult, as almost all funding bodies give money to an array of projects ranging from laboratory basic science to clinical epidemiology and psychosocial research. In addition, significant amounts of funding are allocated to career awards, which provide salaries for university-based researchers. Universities are expected to cover overhead costs, although biomedical research is shifting increasingly toward hospital-affiliated and -based research institutes that free scientists from teaching and other university obligations. In addition to public sector support of research, philanthropic organizations, particularly those focused on a given condition (e.g., the Canadian Cancer Society, the Heart and Stroke Foundation), are important funding sources for investigator-initiated research.

Industry also funds research, but the level of spending is nearly impossible to measure for proprietary reasons. The promise of increased corporate research spending was one of the justifications for recent federal legislation extending patent protection on pharmaceutical products. To date, industry has favored channeling funds to established university-based researchers rather than investing in "bricks and mortar" to build free-standing research institutes.

Technology assessment organizations are another source of funds for research. Recent directed grant competitions in Quebec and British Columbia, operating through requests for proposals limited to technology assessment, indicate that technology assessment is an area of growing importance for research funding bodies. The national body, the Canadian Coordinating Office for Health Technology Assessment (CCOHTA), was established with a fairly rudimentary budget for research; however, it has recently been directed by the Conference of Deputy Ministers to strengthen its research efforts. In addition, several provincial bodies, including CETS in Quebec, have allocated some of their budgets to generate information of particular relevance to ongoing or impending assessments. The Ontario and Manitoba governments have funded university-based research groups with the understanding that some portion of their efforts will be directed to policy-relevant research.

Although Canada lags in government-funded research, Canadian scientists have managed to produce valuable advances, both in the laboratory and in addressing policy issues. Given the great need for health services research and the availability of administrative and other data sources in the universal health insurance system, research pertinent to technology assessment appears poised to take over a greater share of Canadian spending on biomedical research.

Control of Pharmaceuticals

Pharmaceuticals are the most formally regulated of technologies in the Canadian health care system, and have been increasingly targeted for systematic assessment. Several vehicles have been proposed for this task, including a federal-provincial undertaking to establish a stand-alone body for assessing pharmaceuticals (50). Part of the tension surrounding the creation of such a body stems from concern over the degree of likely duplication of activities already underway at CCOHTA and in provincial drug and technology assessment bodies. Regardless of who ends up doing the work, systematic assessment of pharmaceuticals can only grow in importance over the next decade.

Marketing Authorization and Patent Protection

The Food and Drug Act requires that before a pharmaceutical can be authorized for marketing in Canada, its safety and efficacy must be demon-

strated. Authorization is the responsibility of the Health Protection Branch of Health and Welfare Canada. Implementing post-marketing surveillance mechanisms is a recognized need but remains a largely unfinished project.

Over the past few years, pharmaceutical patent protection, which falls under federal jurisdiction, has been a prominent issue in Canada. Legislation in effect in the early 1980s was said to provide the weakest patent protection among industrialized nations. In 1987, following commitments of the pharmaceutical industry to increase research and development investment in Canada, the federal government adopted Bill C-22, which increased the patent duration for pharmaceuticals and essentially ended a system of compulsory licensing that had benefited manufacturers of generic drugs.

Early in 1993 the Canadian parliament adopted a new act increasing patent protection from 17 to 20 years. Given the strong likelihood that longer patent protection would increase pharmaceutical prices and thus provincial expenditures, several provinces protested the legislation. However, Quebec, home to roughly half of Canada's patented medicine industry, supported the change. According to the Pharmaceutical Manufacturers Association of Canada, the proportion of sales revenue allocated by its members to research and development increased from 3 percent in 1979 to 10 percent in 1992. The legislation extending patent duration contains neither a provision for independent assessment of the degree to which the pharmaceutical industry meets its promises to increase research spending in Canada, nor penalties for shortfalls.

Of concern to Canadian policy makers has been evidence regarding the prices of patented medicines in Canada. According to a recent study produced by the Patented Medicine Prices Review Board (a federal surveillance organization established as part of the C-22 provisions) prices in Canada are higher than in other countries. Drugs with the highest sales volumes were reported to be priced an average 20 percent higher than the median international price, and launch prices of new products were similarly elevated.

Authorized Drugs and Prices

Most provinces prepare formularies (lists of authorized drugs) to manage their pharmaceutical services programs. In Quebec, the government body charged with advising the minister in this regard is the *Conseil Consultatif de Pharmacologic* (CCP). The Council's recommendations must, by legislation, consider the therapeutic value of pharmaceuticals and the fairness of their price. The CCP has also recently commissioned a user's guide for certain expensive drugs whose indications are controversial, such as thrombolytics, erythropoietin, and colony-stimulating factors. There are two regularly updated formularies, one for pharmaceuticals provided in health care facilities and the other for those provided outside such facilities to welfare recipients and all persons over age 65. (These are the only ambulatory patients whose prescription drug costs are insured by public programs in Quebec.) Other provinces generally have similar programs with the exception of Saskatchewan, which insures prescription drug costs for all citizens.

For services to hospitalized patients, drugs are limited to those on the formulary. However, exception mechanisms are provided and widely used. The formulary does not set the prices paid for drugs; their cost is covered directly by the global budget of the relevant institution. To minimize drug expenses, most drugs are purchased in bulk.

The formulary for services to eligible elderly and indigent ambulatory patients includes not only the drugs covered but also the price reimbursed by the provincial health insurance plan (RAMQ). This program covers only drugs prescribed by a doctor or dentist. Until recently, a median-price policy was used, setting the maximum allowable reimbursement for a drug at the median price for that category of drug. For more expensive drugs, the patient pays the cost difference (unless it is assumed by the pharmacist).

Changes implemented early in 1993 established guaranteed sales prices. Under this scheme, manufacturers agree to firm prices for their products for a period of six months, and wholesalers agree to a set percentage for distribution charges.

These promises form the basis of the price appearing in the formulary; however, the price must not be higher than it is in other Canadian provinces.

This drug program for ambulatory patients accounts for about 4 percent of public health care expenditures. Its cost increases have been the fastest and the most difficult to control. From 1987 to 1991, drug expenditures rose an average of 16 percent annually, resulting equally from higher costs per drug and higher numbers of prescriptions (65). In 1992 the government imposed a $2 user fee per prescription for elderly patients not receiving a guaranteed income supplement. This change was perceived by some as a first breach of free access to services guaranteed by the Canada Health Act, hence as the first step toward widespread user fees to control costs.

Control of Medical Equipment

Marketing Controls

Current regulatory mechanisms for medical devices are much less developed than those for pharmaceuticals. Regulation of medical devices is a federal responsibility and aims to make manufacturers or importers responsible for safety and effectiveness. Manufacturers or importers are required to register devices marketed in Canada with Health and Welfare Canada and to comply with labeling standards specifying (among other things) who is responsible for the products. A small number of explicit standards apply to specific products.

Users of medical devices are urged to inform the federal Health Protection Branch's Bureau of Radiation and Medical Devices (BRMD) of any problem they encounter with these products, especially regarding safety. Nevertheless, device regulation is not an obstacle to the introduction of innovative medical devices in Canada. The relative lack of regulatory requirements for certification and disclosure of devices as compared with pharmaceuticals has recently created controversy, particularly regarding breast implants. This situation may shift with recent changes in device evaluation requirements by the federal BRMD and an increased focus on devices with particularly high risks (67).

Capita/ Expenditures by Hospitals

In Quebec rules governing hospital acquisition and funding of medical equipment differ for replacing equipment and for developing new services. If an acquisition does not entail an increase in operating costs, the institution may finance the purchase with a line of credit granted to it by the Quebec Ministry of Health and Social Services (MSSS) for capital and equipment expenditures. However, the regional authority's authorization is required if the purchase falls into one of the following categories:

- medical imaging,
- radioisotopes and laboratory automation,
- electronic patient monitoring,
- radiation therapy,
- anesthesia and resuscitation,
- hemodialysis, or
- pacemaker implantation.

If one of these projects is authorized, the regional authority may help finance the purchase through a line of credit allocated to the region by the ministry. Half of available capital funds for a given region are managed by the regional authorities; this gives them considerable influence and planning power over the distribution of medical equipment.

If the project entails an increase in operating expenses or will provide new, so-called superspecialized services, the institution must obtain written authorization from the minister, who consults the regional authority before making a decision. Superspecialized services include:

- cardiac surgery,
- neonatal surgery,
- neurosurgery,
- organ transplants,
- bone marrow transplants,
- neonatal intensive care and bum units, hemodialysis,
- high-risk pregnancy units,
- radiation therapy,

- computed tomography (CT) scanning,
- magnetic resonance imaging (MRI),
- photon- or positron-emission tomography, and
- extracorporeal shock wave lithotripsy.

If a project is authorized, MSSS funds are approved for capital expenditures and a negotiated portion of operating expenses. In recent years this funding has tended not to coverall the costs, leaving a large gap to be filled by other sources—in particular, hospital fundraising campaigns. Government funding for these services usually covers half of capital costs.

Placement of Services

Planning

For superspecialized services, centralized review and funding of new services are the main regulatory mechanisms controlling their placement. In Quebec the MSSS has established committees of medical experts; local, regional, and provincial administrators; and, in some cases, representatives from patient associations who recommend how to orient the organization and development of these services. This planning, which is open to considerations of health care technology assessment, has had a major impact on service placement.

Permits for Private Laboratories

In Quebec anyone wishing to operate a private medical laboratory or diagnostic x-ray facility must obtain a permit from the MSSS. The Public Health Protection Act stipulates that such a permit may be denied if the needs of the region do not justify it. The Act provides some control over the organization of services outside hospitals. As a result, most laboratory services are dispensed by hospitals.

The private sector's share of medical laboratory output is less than 5 percent as only services provided in hospitals are insured. (In contrast, in Ontario about half of all medical laboratory services are provided outside hospitals in privately owned laboratories.) Unlike medical laboratory services, diagnostic X-ray services provided by private facilities are insured in Quebec. For the most part these facilities are located in large urban centers, and their output represents about a third of all x-ray services.

Decisions on Coverage

Decisions on insurance coverage shape service placement, as a given service maybe covered only in hospitals. Such is the case with obstetrical ultrasound in Quebec so as to prevent duplication of services by hospitals and private clinics and to limit overutilization. Additionally, by limiting coverage to hospitals, obstetrical ultrasound falls under the global budget, which promotes substitution of services. These administrative decisions, although not explicitly limiting the amount of a technology in place, have a general uptake-retarding effect when combined with global hospital budgets. Services may also be insured only in specific locations; an example is extracorporeal biliary Iithotripsy, for which agreements administered by the provincial health insurance plan state that the service is covered only in three hospitals designated by the minister.

Control of Health Care Providers

Medical Personnel

One way to control the use of health care technology is by regulating the numbers and training of medical personnel. Several provinces have attempted to limit the growth in the number of physicians. In the 1980s Quebec used quotas for residency and internship positions but despite this, the number of doctors increased two to three times more quickly than the population. The government has recently announced firmer action with regard to medical school enrollments to make growth in the number of physicians more congruent with demographic changes (60).

TABLE 3-2: Breast Thermography in Quebec, 1972–1980

Year	Number of examinations	Total costs ($ Canada)	Proportion in private clinics (in percent)
1972	4,695	$ 134,295	77%
1973	11,791	349,965	79
1974	25,256	752,772	86
1975	61,070	1,820,012	98
1976	89,141	2,659,608	96
1977	12,693	380,415	99
1978	5	25	0
1979	0	0	0
1980	4	20	0

SOURCE R Jacob Quebec Ministry of Health and Social Services, personal communication 1994

Ceilings on Physician Revenue

Regulated ceilings on gross revenue earned by doctors have been instituted to counter incentives for expansion inherent in fee-for-service remuneration. In Quebec the limits are individual for general practitioners and collective for specialists. For general practitioners a quarterly revenue ceiling is set above which there is a 75 percent reduction in fees paid for services rendered. For specialists an average annual target revenue is negotiated between the MSSS and the Federation of Medical Specialists (FMSQ) for the entire group. Targets for each specialty practice are then negotiated within the FMSQ. If, during a given year, the average target revenue is exceeded, fee adjustments are negotiated downward for the following year to compensate for overages.

In addition, activit y ceilings for certain services and practice revenue ceilings for some specialties are set out in agreements with physician organizations. For example, in 1992 any radiologist performing more than 25,000 examinations and receiving more than $214,000 in practice revenue would have his or her fees above these limits reduced by 75 percent for the remainder of the calendar year.

Conditions for Coverage of Services

Fee schedules and locations for insurable services can be used to regulate volumes for specific services. For instance, in Quebec the soaring use of injections of sclerosing agents to treat varicose veins from 1970 to 1974 was both curtailed and redirected toward specialists by fee schedule changes (54).

Limiting the locations where the service was insured was used to regulate use of breast thermography. From 1972 to 1976, thermography use skyrocketed in Quebec as the annual number of examinations increased from 4,500 to about 90,000 (table 3-2). More than 95 percent of these examinations were performed in private x-ray laboratories. A generous fee for a technology requiring no major investment and involving few risks made this procedure an attractive opportunity for some radiologists. However, rapid increases in output and expenditures led the MSSS and the FMSQ to review the data on thermography's effectiveness. The procedure is not very sensitive (a conclusion that was later reached at a U.S. National Institutes of Health consensus conference as well) and should not be used routinely in breast cancer screening programs (123). In 1976, following negotiations with the FMSQ, the government deinsured the service in private laboratories. Despite continued coverage in hospitals, thermography was completely discontinued by 1978.

Control of Provider Locations

In Quebec the government has implemented several policies to ensure an equitable distribution of physicians in the province. These include:

- scholarships to medical students who agree to practice in areas short of physicians
  isolation bonuses for doctors in remote areas;
- differential remuneration for new physicians: reduced (70 percent) in regions where there is an adequate supply and increased (for general practitioners, 115 percent, specialists, 120 percent) in designated areas; and
- incentives for establishing and remaining in practice in remote areas, minimum revenue guarantees, and grants for specialized training for doctors in designated areas.

The distribution of general practitioners is generally agreed to be satisfactory, but that of specialists is still suboptimal, with heavy concentrations in the three urban regions where faculties of medicine are located. Some basic specialties, including general surgery, internal medicine, psychiatry, obstetrics, anesthesia, and radiology, continue to be unevenly distributed. The implications of this imbalance are unclear, as CETS recently reported that rural residence does not appear to be associated with decreased rates of any of nine common surgeries (36). Nevertheless, legislation requiring the definition and implementation of medical staffing plans for each region was recently enacted to address physician distribution.

Efficacy of Control Mechanisms

Cost Control

With 8.7 percent of its gross national product going to health care in 1989, Canada ranked second in the world in per capita health spending after the United States (109). Growth in health care spending is generally considered under control in Canada, in contrast to the situation in the United States (48,49). Canada's universal public health insurance plan, permitting the collective purchase of health care services, appears to be the main factor responsible for these differences.

Given strict control over the number of hospital beds available, Quebec's experience suggests that growth in hospital spending has been successfully limited by global budgeting limiting the volume of resources utilized in the hospital sector (40). For physician services, costs were initially controlled by slowing price growth through contractual negotiation and, more recently, by controlling the volumes of services provided by physicians.

The question of underfunding arises frequently. As noted earlier, obsolescent equipment and technological lag are concerns often raised by observers of the Canadian experience and are taken as indications that the system is underfunded (73). In the case of obsolescent equipment, the Quebec experience with medical imaging suggests that use of this technology is high and that the equipment pool is constantly growing. Data comparing Canada and the United States indicate a 20 percent higher rate of exams per population in Canada (75). However, a clear preference for using available funds for new equipment rather than consolidating and upgrading existing equipment means that older, serviceable equipment may well continue to be used.

Technological lag is striking only in relation to the United States. In the case of capital-intensive equipment, financial and regulatory control mechanisms clearly slow diffusion. Less capital-intensive technologies not subject to these mechanisms, such as ultrasound, usually diffuse at a rapid pace, as illustrated by the data in table 3-3. In any case, evidence of obsolescence or technological lag leading to suboptimal health outcomes is difficult to find.

Equal Access to Services

In Canada the publicly funded, universal health insurance plan guarantees the entire population access to health services. Care whose cost is not reimbursed, personal financial disasters linked to illness, and uninsured patients are eliminated. At least for hospital services, the data show that the volume of services used is largely determined by need, not personal income (86).

TABLE 3-3: Diffusion of Ultrasound in Quebec, 1977–1984

Year	Hospitals reporting use	Annual rate of increase	Specialized hospitals as proportion of users
Before 1977	13	—	16,9%
1977	16	23.1%	18.8
1978	22	375	27.3
1979	30	36.4	46,7
1980	43	43,3	44.2
1981	54	25,5	51.8
1982	63	16.6	58,7
1983	71	12,7	549
1984	76	7,0	56.6

SOURCE R Jacob, Quebec Ministry of Health and Social Services, personal communication, 1994

In Quebec proximity to resources is still variable, reflecting the nonuniform distribution of the population. People living in areas far from large urban centers continue to travel to receive many services, even in cases where it would be reasonable to provide these services closer by. Although steps are being taken to address this situation, studies analyzing geographic variations in utilization rates of certain services in Quebec have not demonstrated a lower level of use in remote areas than in areas where resources are concentrated. On the contrary, for elective surgery, utilization seems to be higher in remote areas (36).

Efficiency

In Quebec resource limitations imposed by global budgeting are forcing hospitals to consider efficiency in decisionmaking, creating a context favorable to health care technology assessment. The combination of pressure exerted by the global budget and the production of timely, pertinent assessment data has resulted in efficient choices in such cases as the use of contrast media in radiology, thrombolytics, and the reuse of hemodialyzer filters (32).

Organizing superspecialized services efficiently remains difficult, however. In these sectors, particularly tertiary cardiology and organ transplantation, resources are suboptimally dispersed, for these services are dispensed in a large number of hospitals—several of which have low volumes of activity. Various studies have shown that health outcomes improve and average costs fall as volumes of activity increase in superspecialized services (33).

Individual hospitals, however, tend to approve projects proposed by their physicians aimed at developing high-tech services. Resource dispersion then results when the hospitals' individual global budgets prevent their achieving levels of activity generally recognized as sufficient to guarantee good performance. External review mechanisms for these projects have not been very effective. Superspecialized services are currently being examined by planning committees with a broad representation of experts and managers, and their restructuring is an MSSS priority.

HEALTH CARE TECHNOLOGY ASSESSMENT

The Canadian Task Force on the Periodic Health Examination (CTFPHE) is an early example of organized technology assessment in Canada. Established by the Conference of Deputy Ministers of Health in 1976, the CTFPHE was mandated to summarize scientific information on clinical preventive services in order to make recommendations to practicing physicians. The CTFPHE was established soon after the Lalonde report appeared in 1975 (83).

This report (published under the auspices of then-Minister of National Health and Welfare Marc Lalonde) argued for a reorientation of Canada's health care system and spending toward pre-

ventive services and practices. In this climate the CTFPHE was seen as a logical step toward preventive health care.

Members of the CTFPHE were chosen on the basis of their credibility as scientists. The CTFPHE began by establishing systems for grading scientific evidence based on methodological quality (an exercise that broke new ground in this area). Recommendations were then to be published on whether decisions to implement specific interventions were supported by scientific evidence. The first report was released in 1979. The CTFPHE is currently revising all of its recommendations for re-release in 1994 (21).

In addition, there have been several consensus conferences in Canada addressing clinical decisionmaking and targeting their findings to practicing physicians (e.g., 1988 Consensus Conference on Cholesterol). Despite some minor differences in organization, scope of final reports, and the actual conference process, consensus conferences in Canada are broadly similar to those in other countries (89). The impact of consensus reports in Canada has been generally weak. Systematic investigation of the effects of a consensus statement recommending reduced rates of cesarean section led to a conclusion that statements had had little effect in the absence of specific incentives or disincentives for their adoption (85).

The measurable impact of CTFPHE recommendations on practice has been similarly weak. Initial dissemination strategies, focusing on publication of recommendations in the *Canadian Medical Association Journal* and *L' Union Me'dicale du Canada,* appear to have been less effective than had been expected. The growing recognition of the importance of actively targeting such information to practitioners as part of a comprehensive dissemination strategy bodes well for increased impact of CTFPHE recommendations in the future.

Although the CTFPHE was created relatively easily by the Conference of Deputy Ministers, various proposals for a national technology assessment body went unrealized, perhaps reflecting a lack of consensus on the broader role of technology assessment in the Canadian health care system **(51).** Throughout the 1980s, the federal government's ability to spearhead a national technology assessment effort was increasingly weakened by federal attempts to shift health care financing to the provincial governments. With decreased federal financial leverage and a climate of federal-provincial tension, activity shifted to the provinces.

Canada's first operational technology assessment body was established in Quebec in 1988. CETS was mandated to promote, support, and produce assessments of health care technologies; to counsel the Minister of Health and Social Services, and to disseminate its syntheses and summaries of available knowledge to all the key constituencies of Quebec's health care system (28). Operationally, CETS draws on the skills of a permanent secretariat complemented by a scientific panel and outside experts retained for specific projects.

In 1991 CETS' 11 reports were examined and their impacts determined by an independent consulting firm. The consultant concluded that 9 of the 11 reports had measurable impact and that CETS' performance compared favorably with that of the Swedish Council for Health Care Technology Assessment (46). Estimated efficiency gains as a result of policy decisions that implemented CETS conclusions amounted to $24.9 million (77).

In evaluating the overall performance of CETS, the consultant noted that the Council had succeeded in establishing its credibility and in developing the appropriate scope and quality for its products. The consultant recommended that CETS promote awareness of its mandate and activities much more vigorously (46). This need for increased attention to dissemination parallels that found with the CTFPHE.

At the national level, unanimity among the provinces remained elusive despite awareness of Quebec's activities and calls for a national effort in health care technology assessment. In 1989, shortly after CETS' creation, an interprovincial symposium on technology assessment was organized to bring together federal and provincial officials and academics. At this meeting federal and pro-

vincial governments agreed to establish and fund jointly the Canadian Coordinating Office for Health Technology Assessment (CCOHTA).

In 1990 CCOHTA was formally created with a modest annual budget of approximately $500,000. This appears to have represented a compromise between provincial interests in a coordinating and clearinghouse role for a national body, and concern that a body fully equipped to assess technologies might lead to federally mandated national standards. To put this budget into perspective, CETS in Quebec began with an annual budget of $800,000, which increased in 1992-93 to $1 million. Emerging from these tentative beginnings, CCOHTA was established as a nonprofit corporation whose board of directors includes the 13 Deputy Ministers of Health or their designates.

CCOHTA'S mandate includes the following six tasks:

- to establish a clearinghouse for information on health care technology assessment;
- to analyze, synthesize, and disseminate health technology information;
- to perform an "early warning" function regarding emerging technologies in the health care system;
- to pursue opportunities for cooperative ventures with technology assessment agencies in Canadian provinces and in other countries;
- to establish links with health care organizations, professional associations, health care providers, and provincial and territorial health departments; and
- to identify areas where information vital to decisionmaking on health technologies is lacking and to stimulate research in these areas (22).

Initially granted a three-year term, CCOHTA has recently been reviewed and will continue to receive financial support from the provincial and federal governments while also pursuing an expanded role in assessing pharmaceuticals. In the review CCOHTA was generally commended for its work to date; as with the CTFPHE, its dissemination efforts were highlighted for attention (14).

By 1993 four provinces had established a technology assessment body or group. In 1991 British Columbia established the British Columbia Office of Health Technology Assessment (BCOHTA), with an annual budget of $350,000. The BCOHTA is located within the University of British Columbia and is mandated "to promote and encourage the use of assessment research in policy and planning activities at the government level and in policy, acquisition, and utilization decisions at the clinical, operation, and government levels" (15). The provinces of Alberta and Saskatchewan are also establishing technology assessment efforts.

In addition to formal technology assessment bodies, provincial governments, particularly in Ontario, have turned to university-based centers for information relevant to policy. In Ontario the Center for Health Economics and Policy Analysis (CHEPA) at McMaster University is funded by the provincial government, the university, and other sources. In 1992 the Institute for Clinical Evaluative Sciences (ICES) was established at the University of Toronto as a joint venture of the provincial government and the Ontario Medical Association (OMA). ICES is intended to provide information relevant for decisionmaking to the joint management committee established by the provincial health ministry and the OMA. Similarly, in Manitoba the provincial government funds a university -aftlliated health services research center at the University of Manitoba.

Further complementing these groups is Canada's expertise in clinical epidemiology and health services research. Extensive university-based training programs exist at a number of Canadian universities, including McMaster, McGill, and the universities of Montreal, Ottawa, and Toronto. These programs not only provide training but have also raised consciousness about the evaluation of health services in medical curricula across the country and have fostered practitioner recep-

tiveness to the products of health services research and technology assessment.

The growing network of technology assessment bodies in Canada parallels a growing demand for such information from a variety of stakeholders in the health care system. Provincial governments, faced with rapidly rising health care expenditures, are interested in anything that can improve decisionmaking. Despite the politically charged nature of decisionmaking on health care in Canada, most parties have accepted that there is a role for a more dispassionate consideration of the effects of technologies. The relative freedom of Canadian technology assessment bodies from bureaucratic direction and control has made their products increasingly palatable to both policymakers and stakeholders.

Increasingly, too, the Canadian public is demanding more information on health technologies. Under the single-payer, publicly administered system of health insurance, increased expenditures on health care are perceived less as a transfer from consumers to suppliers than as a transfer from one area of governmental responsibility to another. Faced with information needs and public pressure to act, decisionmakers have frequently turned to technology assessment bodies for input and recommendations.

Physician and health professional organizations, however, have been somewhat wary of coordinated technology assessment activities. Although individual physicians are involved in technology assessment as academics, reviewers, or employees of technology assessment bodies, professional organizations have only recently begun to see technology assessment as meriting attention. There are signs that this may change with a growing interest in quality assessment and assurance in a general climate of cost concerns. Quality issues have spawned growing interest in clinical practice guidelines, extending the CTFPHE model beyond preventive services. In 1992 the Canadian Medical Association (CMA), as a leader of the National Partnership for Quality in Health (NAPAQH) organized a workshop to develop "guidelines for guideline developers." Despite misgivings about national-level efforts, participants identified four "action items":

- develop a definition of quality reflecting both process and outcomes of care,
- hold a national workshop to develop a manual outlining practical methods for guideline development,
  establish a network of guideline developers to foster standardized methods and avoid duplication, and
- maintain an updated database of clinical practice guidelines that would be available to practitioners and patients (19,42).

While different from quality assessment, technology assessment shares a need for information, for synthesis of evidence, and for dissemination (45,82). Potential cooperation between technology assessment and quality-of-care initiatives may bring physicians more centrally into decisionmaking on the optimal use of health care technologies.

Technology assessment has not been simply an active choice on the part of policy makers; rather, the Canadian health care system has become conducive to incorporating the results of technology assessment in decisionmaking. Canada's one-payer system of universal health insurance allows for rationality in planning and decisionmaking about health technologies, as provincial governments can exercise a fair degree of control over budgets and insurable services. In addition, the public character of the system creates a receptiveness among political decisionmakers for technical information that can help them avoid the appearance of making difficult allocation decisions solely on political grounds. This receptiveness should continue to grow in Canada as provincial governments increasingly try to curtail expenditure growth that results from mounting demands for health services from an aging population, compounded by poor economic conditions.

Case studies

TREATMENTS FOR CORONARY ARTERY DISEASE

In Canada coronary artery disease is a significant cause of mortality and morbidity. Nevertheless, despite an aging population, death rates fell throughout the 1980s, as shown in table 3-4 (1 12,1 13). Increasing numbers of hospital admissions for these conditions (and decreased lengths of stay per admission) suggest that hospital-based intervention is the major therapy for coronary artery disease.

Canada's first cardiac catheterization was performed in 1946 and was followed by the first open heart surgery in 1968. Percutaneous transluminal coronary angioplasty (PTCA) was introduced during the 1980s and has spread rapidly. By 1993, 37 centers were offering open heart surgery—including correction of congenital abnormalities, valve surgery, and coronary artery bypass grafting (CABG)—and 78 centers had cardiac catheterization facilities (25). All provinces except Prince Edward Island have at least one hospital performing CABG and at least one with catheterization facilities. In the smaller provinces these are usually the same facility.

In contrast, the number of procedures performed in the United States is proportionately three times greater. The average annual number of procedures per facility in Canada is roughly 500, as compared with 200 in the United States, which has many more facilities for catheterization (24). Similarly, population rates of CABG are markedly higher in the United States than in Canada. CABG rates in New York and California were consistently 25 to 80 percent higher than those in Ontario, Manitoba, and British Columbia between 1983 and 1989. Three-quarters of the difference between California and the three Canadian provinces was attributable to higher rates among elderly Californians, particularly those over 75. CABG rates were lowest for Americans living in low-income areas and highest for Canadians living in low-income areas suggesting that Canada's universal health insurance reduces the influence of income on access to services (2).

In Ontario, Canada's largest province, the number of CABG procedures increased 52 percent between 1979 and 1985. The increase was due in part to the rapidly increasing proportion of older CABG patients (aged 65 and up). This expansion occurred in the absence of data on efficacy or cost-effectiveness in this age group. A randomized trial of this therapy among older patients was advocated (1). Despite these and other studies examining the effects of regionalization and queuing, rapid diffusion of these therapies, particularly CABG and PTCA, has occurred with lesser emphasis on scientific data addressing efficacy or effectiveness and with greater emphasis on consumer and provider demand in light of the perceived efficacy of CABG and PTCA (79,98,101).

National utilization data are difficult to gather because of provincial jurisdictions, but utilization data and projections from the province of Quebec illustrate clearly the rapid expansion of volume of procedures (table 3-5) (58,63). Angioplasty use has grown especially rapidly and does not appear to have led to any clear, stable substitution for CABG.

In Quebec a number of working groups and reports have studied tertiary cardiac services. In 1977 the government commissioned a report from a group of physicians that recommended a series of minimum standards and resources for cardiac catheterization facilities (90). In 1986 the federal government drew upon utilization data to estimate that 1,000 cardiac catheterization procedures

TABLE 3-4: Mortality and Morbidity Due to Coronary Artery Disease, 1980 and 1989

	1980	1989
Death rate (per 100,000) due to ischemic heart disease (ICD 410-41 4)		
Female	166	*147*
Male	245	200
Hospital admission rate (per 100,000) for acute myocardial infarction (ICD 41 O)		
Female	128	139
Male	*272*	*269*
Average length of stay for admissions for acute myocardial infarction (days)		
Female	*21.4*	*14.9*
Male	15.7	11.7
Hospital admission rate (per 100,000) for other ischemic heart disease (ICD 411 -414)		
Female	*303*	*286*
Male	*472*	*515*
Average length of stay for admissions for other Ischemic heart disease (days)		
Female	*22.7*	13.4
Male	*13.4*	*8.8*

SOURCE Statistics Canada, Institutional Care Statistica Division, HospitalMorbidity 1981, 1989, Statistics Canada Pub No 82-206 (Ottawa 1983 and 1991), Statistics Canada, Vital Statistics and Disease Registries Section, Causes *of Death,* 1981, 1989, Statistics Canada Pub No 84-203 **(Ottawa 1983 and 1991)**

would be performed annually per 500,000 persons; it then established norms for establishing new cardiac catheterization facilities (96). In Quebec this federal initiative was felt to require supplementation by the provincial government, particularly in light of the growing role of PTCA and the desire to ensure both an optimal distribution of resources and equitable access to tertiary services.

In considering various frameworks for optimizing resource distribution, the government placed great importance on the availability of cardiac surgery services in facilities offering cardiac catheterization. This was deemed essential because of 1) the logical synergy resulting from having diagnostic cardiac catheterization and cardiac surgery in the same facility and 2) the potential need for emergency surgery following cardiac catheterization.

A working document (published in 1988 and revised in January 1989) proposed a framework for ensuring access to high-quality cardiac catheterization services while optimizing resources (57). This framework included a model for projecting future years' volumes as well as the assumptions that maximal use of a cardiac catheterization facility would be 1,500 hours annually and that optimal use would be deemed to be 85 percent of this time, or 1,275 hours. Furthermore, diagnostic cardiac catheterization was assumed to require one hour of cardiac catheterization facility time; angioplasty, two hours. The report concluded with a series of short- and medium- to long-term recommendations regarding the optimal distribution of new services and assignment of responsibility for certain geographic regions to existing facilities.

Shortly after the 1989 revision was published, public pressure on the MSSS over waiting lists for elective cardiac surgery led to the creation of a working group to address the entire tertiary cardiac care sector comprising both diagnosis and

TABLE 3-5: Use of Catheterization, Angioplasty, and CABG in Quebec, 1979–1990

Year	Diagnostic catheterization	Angioplasty (PTCA)	Coronary artery bypass grafting
1979	7,314	0	1,780
1980	8,377	0	2,166
1981	8,665	0	2,171
1982	9,221	0	2,364
1983	10,366	0	2,940
1984	10,362	351	2,868
1985	10,781	1,033	2,988
1986	11,538	1,589	2,719
1987	12,907	2,195	3,337
1988	13,790	2,812	3,582
1989	13,718	3,110	4,308
1990	15,268	3,681	3,642
[a]994-95	17,607	5,590	5,282

[a]Projected

SOURCE Gouvernement du Que'bec, Ministe're de la Sante' et des Services sociaux, "Les Services Tertiaires en Cardiologies, " rapport du groupe de travail sur la revascularlsahon coronarlenne, Quebec, June 1990), Gouvernement du Quebec, Ministere de la Sante' et des Services soclaux, "Gestion de l Accessibilite aux Services de Cardiologie Tertiaire, " rapport du groupe de travail - document de travail, Quebec, May 1992

treatment of ischemic heart disease (58). After considering epidemiologic data, projections of future requirements, and available resources for cardiac catheterization, the report reaffirmed the centrality of the goal of ensuring access to high-quality services while optimizing resources committed to this sector. The working group specifically recognized the "major problem" of waiting lists for elective cardiac services and noted that their elimination should be an important consideration in resource allocation. Specific recommendations regarding optimal resource allocation included 1) offering four new cardiac surgery services, 2) establishing angioplasty only where cardiac surgery facilities were already in place, and 3) creating a provincial coordination mechanism to establish priorities for waiting 1ists, coupled with improving the coordination of services to reduce average waiting time (58).

Following the release of this report, the Minister announced a three-year plan for addressing the report's recommendations. This process included a working group to recommend ways to improve administration of these services. This group's preliminary report (issued in May 1992) identified three solutions to the waiting list problem:

- an increase in resources to more closely approximate demand for these services,
- a system of four "supraregional" waiting lists to which persons would be added only after evaluation and assignment of priority, and
- formalizing "interregional corridors" for transferring persons on waiting lists to centers with resources (63).

The report also included a seven-level priority scheme for diagnostic cardiac catheterization, angioplasty, and CABG. This scheme is based largely on a classification of angina and left ventricle ejection fraction combined with results from noninvasive tests to diagnose reversible ischemia. In addition, the report suggested that waiting list

TABLE 3-6: CT and MRI Scanners in Canada, 1993

Province	CT scanners		MRI scanners	
	Number	Number per million	Number	Number per million
Newfoundland	6	10.6	1	1.76
prince Edward Island	1	7.7	0	0
Nova Scotia	8	8.9	1	1.11
New Brunswick	7	9.7	0	0
Quebec	60	8.7	5	0.73
Ontario	72	7.1	11	1.09
Manitoba	9	8.2	1	0.92
Saskatchewan	6	6.1	1	1,01
Alberta	24	9.4	5	1,96
British Columbia	23	7.0	5	1.52
Canada	**216**	**7.9**	30	**1.10**

SOURCE Canadian Coordinating Office for Health Technology Assessment, Technology Brief, No 53 (Ottawa 1994)

times for lowest priority, elective coronary angiography should not exceed six months.

CETS also reported on the optimal distribution of cardiac catheterization laboratories (27). Published in 1989, its report stated that centralizing cardiac catheterization facilities in hospitals with active cardiac surgery programs would be desirable. Furthermore, the report stated that angioplasty should be used only in hospitals with cardiac surgery facilities. This report was produced at the request of the Minister for the working group addressing the distribution of tertiary cardiac services. The findings were retained by the working group and have had an important influence on its recommendations.

Throughout the 1980s, Quebec faced increasing demand for both diagnostic and therapeutic cardiac intervention services. Political pressure on the provincial government led to consultation and studies and a subsequent series of budgetary and administrative solutions designed to meet these increasing demands. Because the government is the sole payer for health services, solutions are proposed with the expectation that the government will implement them. In this climate the pressure both to recognize a problem and to do something about it fosters a demand for rationality in decisionmaking and, consequently, for technology assessment.

MEDICAL IMAGING (CT AND MRI)

Medical imaging technologies have been particularly prominent in Canadian debates and policymaking on health technologies. Part of this is undoubtedly due to the capital investment required to acquire and operate these facilities, particularly in the case of CT and MRI. These two diagnostic modalities draw particular attention in Canada because of the explicit budgeting undertaken by provincial governments for capital expenditures in the health sector. Each province has its own version of cost thresholds or categories of services that require hospitals seeking to introduce a new service to apply to the provincial government for funds explicitly tied to the new service. Even the most efficient hospitals would be hard pressed to generate sufficient surplus operating funds to acquire CT or MRI equipment and to cover the operating costs (see table 3-6) (25).

Computed Tomography (CT)

The first CT scanner was installed in Canada in 1973 at the Montreal Neurological Institute. This technology diffused rather rapidly, and 216 scanners were reported to be operating in 186 Canadian hospitals in 1993 (25). The story of CT diffusion in Canada's two largest provinces, On-

tario and Quebec, provides a number of lessons for considering expensive new technologies.

The general pattern in Ontario has been summarized as a cycle of reactive, ineffective policy-making by governments punctuated by continued efforts by hospitals to circumvent policies perceived to be limiting acquisition or diffusion of CT scanners (41). Responding to requests for funds for CT scanners in 1973, the provincial government established a Provincial Program Advisory Committee (PPAC) to consider policy on CT in Ontario. A year later the province first scanner was installed in Toronto and was treated as any other capital purchase with depreciation over five years and operating expenses to be met from the hospital's existing budget. Shortly thereafter, PPAC recommended that the province fund five scanners, one at each university center. The rapid development of technology for body scanners further fueled demand for this service among Ontario hospitals and led to "illegal scanners" as hospitals affiliated with medical schools purchased scanners without government approval.

Part of the explanation for this appears to be Ontario's lack of penalties for hospitals that acquired scanners without approval. The only sanction applied to such hospitals was the government refusal to allow depreciation allowances or operating costs to be included in the offending hospitals' annual budgets.

Pressured to legitimize these "illegal" CT scanners, Ontario's Ministry of Health developed a three-phase plan for CT services. Phase one covered placement of the initially planned five scanners in university centers. Phase two envisioned a total of 17 scanners, one for every 500,000 persons. Needs of areas beyond the catchment of the province's university centers were to be addressed during phase three (68).

A succession of policies followed, all quickly circumvented by hospitals and having little effect on CT scanner diffusion in Ontario. In 1981 the province revised its target upward to one scanner per 300,000 persons. By 1986.42 scanners were operating, and funding for an additional five had been approved—surpassing the government's revised target with one scanner for every 192,000 persons. By 1993 the number of scanners had reached 72 units and, perhaps, some stability; scanners are now found in every hospital with at least 300 acute care beds and a growing number with fewer (25). The U.S. experience of CT services in private offices beyond the reach of government regulation did not occur to a significant degree in Canada (9).

Ontario's experience with CT scanners provides a lesson in how not to establish policies on technology diffusion and utilization. First, the experts consulted by the governments overwhelmingly represented university-based providers with a particularly strong interest in acquiring the technology. This interest (which is perhaps not altogether unreasonable) appears attributable to the "cutting-edge" mentality of university medical centers and their differential ion. on the basis of access to technology, from hospitals not affiliated with university centers. This differentiation is revealed explicitly in the government's notion that the five university centers were to have been the primary target for diffusion of CT scanners.

Second, a consistently reactive policy focus is insufficient in the face of concerted demand from hospital administrators and providers for a given technology. Through the mid- 1970s. minority governments in Ontario, needing the support of opposition parties to rule and faced with sluggish economic growth, may have had limited ability to establish and enforce policy. The experience suggests, however, that weak policy is of minimal value.

Last, the diffusion of CT scanners in Ontario points to the allure of "big-ticket" items for hospital administrators and other stakeholders. A combination of sufficient autonomy and marketing savvy enabled several institutions to purchase CT scanners with funds from nongovernment sources. Nevertheless, community support, both financial and political, for technology acquisition left the government unwilling to continue refusing to cover operating costs.

Unfortunately, debate and decisions on CT scanners relied rarely, if at all, on scientific data

TABLE 3-7: CT Diffusion and Use in Quebec, 1977–1984

Year	Number of scanners	Examinations per scanner	Examinations per 100,000 people
1977	3	3014	144.4
1979	6	4368	414.1
1981	10	3999	625.0
1983	14	4520	978.2
1985	21	4267	1230,9
1987	35	3553	1872.7
1989	44a	3745a	2460.3[a]
1991	54a	3788[a]	3034.9a

[a]Estimates

SOURCE Gouvernement du Que'bec, Ministe're de la Sante' et des Services sociaux, "L'imagerie Me'dicale au Quebec, " rapport d'une recherche sur Ie phe'nome'ne de deffusion des technologies medicales, Que'bec, 1986.

regarding the technology's efficacy or cost-effectiveness. Aside from initial attempts to decide on a target level of access, the ensuing experience in Ontario had far more to do with politics, marketing and the clout of University of Toronto teaching hospitals.

The process of diffusion of CT scanning was slower and perhaps more orderly in Quebec, where Canada's first scanner was installed, than in Ontario. From 1977 to 1985 both the number of facilities performing CT scans and the number of scans per facility increased (table 3-7) (55).

The key determinant of the initial diffusion of CT scanners in Quebec appears to have been the fact that any such machines would have to be acquired from funds raised by the hospitals themselves, a diffusion policy based on philanthropy (55). Radiologists would be reimbursed by the government-run health insurance system, but until 1984/85, the government provided no funds for equipment acquisition.

The decision to provide such funds in 1984/85 led to the authorization of eight new facilities. These were distributed so as to offset the concentration of scanners in metropolitan Montreal and particularly in the teaching hospitals affiliated with McGill University, which had been most active in community-based fundraising. The goal was to ensure that CT services would be available in all university centers and in any region with a population greater than 200,000. As CT scanning increasingly became a standard technique, its diffusion accelerated such that scanners are now installed in almost all hospitals with more than 200 beds. The fiscal attractiveness of a philanthropy-based diffusion policy eventually gave way to a role for government to address what was perceived to be an increasing lack of equity in access.

Magnetic Resonance Imaging (MRI)

MRI was initially introduced in Canada as a research tool in 1982/83. At that time two units were installed in academic centers in Ontario and one in a similar center in British Columbia. The first clinical uses of MRI began in 1985; since then, 28 additional units have been installed with at least one now in all but two provinces. An additional six units are in various stages of installation (24). In contrast, there are currently over 1,500 MRI units in the United States—a diffusion rate that is roughly sixfold higher on a population basis.

Among the MRI units currently operating, three are notable for their location in private clinics in the western provinces of Alberta and British Columbia. Both have been financed by consortia of private individuals, including physicians who are theoretically referring persons to these facilities. In Calgary, Alberta, private ownership appears to be due in part to the existence of a waiting list of about 1,000 persons with nonacute work-

and sports-related injuries for the one MRI scanner currently in place there (26).

In Quebec a 1991 internal planning report to the MSSS, noting that MRI's "diagnostic superiorit y" remained unproven, considered MRI a service appropriate to university centers (59). Projected demand was estimated to require eight units in the province, of which three were operating and three were under construction as of the report's publication. This view was supported by a subsequent report of CETS on MRI in Quebec (30). This report, noting that MRI technology was rapidly evolving and that its superiority remained unproven, recommended that priority for acquisition be given to university centers with significant caseloads in neurology and neurosurgery.

CETS identified 55 specific cases in which MRI's diagnostic superiority was largely accepted by the professional community. This tempered view has contributed strongly to the relatively slow diffusion of MRI in Quebec. Although some commentators are troubled by the private clinics about to open in Alberta, the Canadian experience with MRI has been generally more orderly than that with CT scanners. To say that lessons learned from the CT experience were applied to MRI would be dangerously optimistic, but several issues deserve comment. First, MRI became available for clinical use in Canada at a time when the level of concern about health care spending, particularly on technology, was higher than at the time CT scanners were introduced. In addition, fairly early in the technology's life cycle, downward revisions of its promise and advantages over CT scanning occurred. As cost concerns throughout the health care system increased in importance, this critical reevaluation of MRI's capabilities served to temper demand.

Second, just as widespread diffusion might have been expected during the late 1980s, Canada's economy plunged into a severe recession, and apolitical consensus began to emerge that the level of government indebtedness was fast becoming intolerable. In such an economic and political environment, government receptiveness to high-profile, capital-intensive health technologies that were not directly life saving was likely to be minimal.

Last, over the past 20 years, a sharper sense of limits has emerged. In addition to the social and economic conditions noted above, Canadian expertise and facility with methods for determining the effectiveness of medical interventions have grown markedly. This has had both direct and indirect effects on policymaking but would generally appear to have contributed to an environment in which scientific data have become an increasingly greater input to policymaking. In the case of MRI, scientific data on effectiveness have remained sufficiently open to interpretation that they have limited widespread diffusion.

Overall Experience With CT and MRI

Canada's experiences with both CT and MRI are similar in that the technologies were first introduced in tertiary-care, university teaching hospitals in large metropolitan areas and then extended to other university centers in smaller urban areas and finally to regional-level community hospitals. With MRI, diffusion beyond university teaching hospitals has yet to occur. The overall pattern occurred, however, with rather less governmental control in the case of CT than for MRI.

Clearly, too, a philanthropy-based diffusion policy requiring no decisions on budgets, locations, or contracts is rather more easily maintained by a provincial government than a series of reactive, lukewarm policy efforts. Nevertheless, equity concerns are likely eventually to require a more active stance regardless of initial postures.

Although predicting the arrival of new, capital-intensive technologies is difficult, the Canadian experience with MRI suggests that there is now a greater role for technology assessment in decisionmaking (at least for such high-profile, big-ticket items) than was the case 20 years ago, when CT scanners first appeared. Whether this policy activism can be applied to other technologies in the health care system remains to be seen.

LAPAROSCOPIC SURGERY

Laparoscopic surgery differs quite markedly from the other technologies surveyed in this book in that it is relatively less capital intensive and requires little new infrastructure. In Canada the recent explosive growth in use of laparoscopic cholecystectomies has occurred with little or no input from the provincial governments that administer the health care system. To date most laparoscopic surgery has been cholecystectomies, although rapid expansion in laparoscopic hernia operations, appendectomies, and thoracic and orthopedic procedures is expected as expertise with laparoscopic techniques spreads. In the absence of utilization data for laparoscopic surgery or administrative records as to its diffusion, this section will focus on Iaparoscopic cholecystectomy, which has been the subject of much scrutiny in Canada.

The first laparoscopic cholecystectomy in Canada was performed in 1990 as a result of a community surgeon's exposure to the technique in Europe (104). Within two and a half years, all hospitals with more than 500 beds, 97 percent of those with 200 to 499 beds, and 78 percent of those with less than 200 beds had adopted this technology (91). Teaching hospitals were earlier adopters than community hospitals, but this may simply reflect bed size, as few community hospitals have more than 500 beds.

By March 1993 at least two-thirds of the hospitals in all regions of the country were using this technology. Preliminary cost data suggest that the average cost per case, based on 1988/89 data, is $3,437 and **$2,605** for open and laparoscopic procedures, respectively. Using these figures and assuming that 88 percent of open cholecystectomies would be replaced by laparoscopic procedures, total annual savings to Canadian health care systems are estimated at $36 million (88).

An assessment of laparoscopic cholecystectomy completed in Saskatchewan considered substitution rates of 30 and 70 percent of open cholecystectomies with laparoscopic procedures. Both scenarios yielded estimated savings of approximately $1,000 per laparoscopic procedure (72). A more recent report using carefully collected prospective study data from a randomized trial of laparoscopic versus minicholecystectomy produced average per-patient costs of $3,169 for minicholecystectomy and $2,889 for laparoscopic cholecystectomy—a savings of approximately 10 percent for the laparoscopic procedure, which is far more modest than previously estimated (35). Furthermore, total savings may be reduced if the number of cholecystectomies increases because of the diffusion of Iaparoscopic methods (87). Anecdotal observations suggest that indications are expanding and that biliary tract injuries represent a growing source of complications in some community hospitals.

It would be comforting to identify a pivotal role for scientific data on efficacy or effectiveness in this rapid diffusion, but the Canadian experience suggests that this diffusion was well under way before any efficacy data from controlled studies became available. At a symposium on laparoscopic cholecystectomy in September 1991 (53,84, 100,104,105) only one presenter reported patient data, a case series of 2,201 patients undergoing laparoscopic cholecystectomy from centers across the country (84). Another article in the June 1992 issue of the *Canadian Journal of Surgery* (in which the symposium papers were published) reported a smaller case series of 258 patients from a single center (44), including 60 cases reported in an earlier report (43). All three series stressed the rarity of complications and concluded that laparoscopic cholecystectomy had become the therapy of choice.

In November 1992a Canadian group published the results of a randomized clinical trial comparing laparoscopic cholecystectomy to mini-cholecystectomy (12). Their data demonstrated shorter hospital stays and convalescence among patients undergoing Iaparoscopic cholecystectomy. In addition, patients undergoing this procedure returned to normal activities earlier than those in the comparison group and had more rapid improvements in post-operative quality of life scores. Nevertheless, the diffusion of laparoscopic chole-

cystectomy was well underway at the time of this study's publication.

In the Canadian health care system, technology diffusion is commonly thought to be under the control of provincial governments, in view of their single-payer role. Nevertheless, a fair degree of flexibility and autonomy remains, particularly regarding the uptake of so-called medium and low technologies. Laparoscopic surgery does not require extensive financial or human resources, and although the instrumentation itself is the product of intensive technological development, its use requires little in the way of support structures additional to those already in place for conventional surgery.

As a result, laparoscopic cholecystectomy's rapid diffusion has occurred in the absence of specific incentives or disincentives offered by provincial governments. Nevertheless, a general desire to reduce bed-days and length of stay, coupled with waiting lists for some forms of surgery, have created a climate in which both physicians and hospital administrators face strong pressures to adopt laparoscopic technology. In addition, factors acting at physician and patient levels accord with administrative interests and have been collectively responsible for the rapid uptake, consistent with the general experience with medium and low technologies (13). Foremost among these factors would appear to be a synergy between a redefinition of general surgery in the face of continuing pressure to specialize, and a demand among consumers for innovative therapies that decrease hospital stays and pain. Some commentators have heralded this confluence, noting with apparent approval the refusal of patients to enter randomized trials comparing treatments, both surgical and otherwise, for symptomatic gallstones (52).

Within surgical practice the increasing role for minimally invasive therapies performed by non-surgeons has been a cause of concern. Extracorporeal shock wave lithotripsy (ESWL) had been touted as a non-surgical treatment for symptomatic gallstones. Recent data show costs of lithotripsy are greater than for laparoscopic removal and recurrence rates are more than 50 percent after ESWL (35). Laparoscopic cholecystectomy's rapid diffusion, due in part to its relatively rapid learning phase, may be interpreted as an attempt by surgeons to reposition themselves within an increasingly competitive therapeutic arena.

Strengthening this view, the Canadian Association of General Surgeons (CAGS) proposed guidelines for laparoscopic cholecystectomy in 1990, two years before the publication of data from the Canadian randomized trial and concurrently with the first reported Canadian case series. The CAGS has a structured relationship with the Royal College of Physicians and Surgeons, and these guidelines were proposed with a view to influencing training programs and certification. The guidelines stressed three points:

1. Only general surgeons experienced with traditional, open cholecystectomy should perform laparoscopic cholecystectomy.
2. Training in laparoscopy should be provided to all interested general surgeons through "appropriate instruction."
3. Training programs should be located in university centers across Canada and developed in coordination with the CAGS to ensure that supervised instruction and practice are part of all such programs (80).

The Canadian experience with laparoscopic cholecystectomy indicates that in the absence of procedure- or technology-specific funding or remuneration features, new technologies diffuse relatively unhindered and in accord with models of medical technology diffusion (91). In addition, receptiveness to stay-reducing technologies among hospital administrators has favored rapid diffusion. Finally, the impact of consumer preference appears to be more important in the case of laparoscopic cholecystectomy than in imaging technologies because of morbidity and aesthetic considerations. In the absence of extensive, well-controlled studies, evaluating the long-term impact of laparoscopic cholecystectomy on the Canadian health care system will be a challenge.

TREATMENTS FOR END-STAGE RENAL DISEASE (ESRD)

Therapies for ESRD include dialysis and renal transplantation; in addition, erythropoietin (EPO) is marketed in Canada. Both dialysis and transplantation are well established, and Canadian health researchers have been quite active in investigating these therapies and their consequences.

This work has been facilitated by the Canadian Organ Replacement Registry (CORR), established in 1981, which has provided valuable information on the natural history of renal failure treated with various therapies (78). The number of people with ESRD has more than doubled over the last decade. In 1991, prevalence of ESRD was 488 per million people, having increased at an average annual rate of 6.8 percent since 1981. Incidence appears to be rising in step with the aging of Canada's population. Between 1981 and 1991, the annual number of newly diagnosed cases increased from 1,197 to 2,568, outstripping population growth over the same interval (20).

Across Canada, the distribution of primary disease leading to ESRD is relatively consistent. In 1991,2,568 new cases of ESRD were added to the CORR. The primary diseases causing ESRD among new cases are shown in table 3-8.

Applying recent prevalence estimates to the entire country yields approximately 13,000 Canadian cases of ESRD. Incidence rates among aboriginal Canadians have been estimated to be 2.5 to 4 times greater than those among nonaboriginal Canadians, in part because of higher risks of diabetes, glomerulonephritis, and pyelonephritis (127).

TABLE 3-8: Causes of New Cases of ESRD, 1991

Primary disease	Proportion of cases (in percent)
Diabetes	**23.8%**
Glomerulonephritis	**18,3**
Renal vascular disease	17.2
Pyelonephritis	7.9
Polycystic kidney disease	5.3
Analgesic abuse	1.4
Others	13.4
Unknown	12.6

SOURCE Canadian Organ Replacement Register, 1991 *Armual Report* (Don Mills, 1993)

Dialysis

Just over half of Canadians with ESRD are treated with dialysis, and just under half of those use some form of home dialysis, a proportion that has increased over the last decade because of the increasing use of peritoneal dialysis. Among those using home dialysis, the proportion using peritoneal dialysis varies from 44 percent in Manitoba to over 90 percent in the Atlantic provinces; the national average is approximately 75 percent. Overall, 62 percent of people in dialysis use hemodialysis and the remainder use peritoneal dialysis (62). The proportion of persons with ESRD receiving dialysis has been decreasing (table 3-9), coincident with an increase in the number of transplantations (20).

CETS has produced two reports relevant to ESRD treatment in Quebec. The first of these addressed the reuse of hemodialyzers and concluded that reuse, if done according to prevailing standards, does not increase the risks associated with dialysis and presents a valuable opportunity for more efficient provision of services. This report served to validate this practice and influence its continuation. Moreover, significant savings would result if reuse rates in Canada rose from approximately 12 percent toward the 72 percent seen in the United States. Savings for Canada as a whole were estimated to be between $5.8 and $5.9 million annually, while reuse for all patients in Quebec would save $2.0 to $2.7 million annually (1 1,32).

I Transplantation

Renal transplantation is increasingly used in treating ESRD-the number of transplants increased from 103 in 1981 to 789 in 1991. In 1991,24 centers offered renal transplantation (20). In that same year the proportion of persons with ESRD in the three largest provinces with functioning trans-

TABLE 3-9: Therapies for ESRD, 1981–1991

Year	Number of persons with ESRD	Percentage on dialysis	Number of renal transplants
1981	**5,576**	**59%**	103
1982	**5,916**	**59**	286
1983	**6,640**	**57**	422
1984	**7,305**	**55**	489
1985	**7,804**	**55**	592
1986	**8,637**	51	749
1987	**9,303**	51	705
1988	10,381	50	815
1989	11,282	50	789
1990	12,067	51	763
1991	13,190	52	789

SOURCE Canadian Organ Replacement Register, 1991 *Annual Report* (Don Mills, 1993)

plants was 53 percent in British Columbia, 46 percent in Ontario, and 45 percent in Quebec.

Advances in immunosuppressive drugs have improved patient survival and graft survival through the 1980s (78). The five-year recipient survival rate is estimated at 93 percent for haplotype-matched organs from living related donors and 83 percent for organs from cadaveric donors. Five-year graft survival rates are 80 and 65 percent for organs from related and cadaveric donors, respectively (62). While renal transplantation is perceived to be superior to dialysis, expanding transplantation services is constrained by donor kidney supply.

In Quebec the first renal transplant was performed in 1958; up through 1990, 2,676 renal transplantations were completed. Approximately 20 percent of these were performed at one urban university teaching hospital (62). Waiting lists and access for persons living in remote areas continue to challenge policy makers.

In 1990 the average waiting time for a cadaveric kidney was 300 days; of 368 persons on the waiting list, 31 percent had been waiting for more than 24 months. Waiting times for transplantation are determined jointly by available resources and immunocompatibility; hence, most of this group are waiting for relatively rare, compatible donors (62).

The second ESRD-relevant report of CETS addressed renal transplantation as part of its overall examination of organ transplantation. The report noted that renal transplantation was both an established therapy and the therapy of choice for ESRD. On the basis of expert opinion, CETS suggested that efficiency and effectiveness would be best served by requiring that centers offering renal transplantation perform a minimum of 20 to 25 transplants annually. Recognizing that transplantation services in Quebec are widely distributed, CETS concluded that although centralization might be advantageous, many of its advantages could be gained from better coordination. Quebec Transplant, the provincial organ procurement organization, was proposed as the best choice for this coordination role, particularly with respect to organ retrieval and distribution and clinical research (33).

Erythropoietin

Erythropoietin (EPO) became available in Canada coincident with its introduction elsewhere. Canadian investigators staged a multicenter trial of EPO and have published several other studies on this technology (18,8 1,99). A study of the cost implications of EPO, published in 1992, used data gathered from the previously reported clinical trial (11 1).

EPO yielded a net increase in costs of $3,425 per patient-year of therapy. Varying assumptions produced a range from a net cost of $8,320 to a net savings of $1,775 per person year. Costs included $10,OOO annually for therapy and an additional $200 for antihypertensive medication; cost offsets were identified from reduced transfusions, reduced numbers of hospital days for EPO-treated persons, and reduced months of dialysis treatment because of increased renal graft survival (111).

In Quebec, EPO'S role in ESRD began with its manufacturer providing the drug free of charge to persons with ESRD, thus generating a market and (in light of its impact) strong demand from recipi -

TABLE 3-10: Formulary Pricing for EPO in Quebec, 1991–1993

Dose	July 1991	January 1992	July 1992	January 1993
4,000 units	$62.13	$62.13	$62.13	$57.00
10,000	146.01	146.01	146.01	133,95

SOURCE Gouvernement du Quebec, Re'gie del'Assurance-Maladle, *Liste de Me'dicaments* (Quebec, 1991)

ents. Once this program ended, nephrologists and persons with ESRD appeared in the media, requesting that the government provide this drug. The government then turned to the *Conseil Consultatif de Pharmacologic* (CCP) for advice.

In 1991, shortly after pressure had been exerted on the Minister, budget supplements totaling $3.2 million were announced for hospitals treating ESRD to defray the cost of EPO. Each center received an amount based on the number of persons treated there who required the drug.

Prices of EPO are difficult to ascertain, but insured prices in the provincial formulary for EPO in the treatment of zidovudine-related anemia among persons infected with human immunodeficiency virus (HIV) are shown in table 3-10 (61).

Overview of ESRD Policy

The treatment of ESRD has been an important focus of policy makers' attention, but management of these programs continues to elude a one-time "master stroke." New technologies, particularly pharmaceuticals (including EPO and new immunosuppressive agents), make long-range planning problematic. More importantly, the "life-and-death" nature of ESRD has prompted micromanagement of resources by the ministry in recognition of the fact that the rapid growth in numbers of affected individuals is not manageable by rigid global budgeting. Although limits exist, particularly in renal transplantation (because of the vagaries of donor supply), accommodation mechanisms have been adopted by the health care system to optimize access to treatment. Yet, given the increasing incidence of ESRD along with increasing rates of survival, planning and managing treatments for ESRD will continue to demand the attention of policy makers.

NEONATAL INTENSIVE CARE

Neonatal intensive care services are distributed across Canada in rough proportion to the nation's 16 medical schools. The country's geography has dictated the regionalization of neonatal intensive care services, and several provinces have an explicit regional, tiered structure of centers providing various levels of obstetric and neonatal care. In Quebec five levels of perinatal care are recognized (table 3-11).

A working group addressing neonatology services in Quebec provided recommendations to the government in a 1992 report (64). The working group was established as a result of the health minister's concern regarding a shortage of neonatology services in Montreal. The group was charged with responsibility for developing a framework for decisionmaking on neonatology services in the province.

The working group noted that vast improvements had been made in care of the newborn but that demand for increasingly specialized intensive care was being driven by the need to care for an increasing number of infants with birthweights between 500 and 750 g. After considering existing services and their utilization, recommendations were made for additional beds and personnel and for followup clinics for high-risk newborns. These were adopted by the ministry.

The working group recognized the difficulty of estimating future demand for neonatal care, particularly in light of technological advances. A prime example of such a technology is extracorporeal membrane oxygenation (ECMO). Examining the decisionmaking surrounding the ECMO center in Quebec offers insights into the role of technology assessment in policy choices.

TABLE 3-11: Neonatal Intensive Care Unit (NICV) Services in Quebec

Level	Number of centers with obstetrical services	Number of NICU beds	Services provided
Primary	**58**	**0**	Provides services for low-risk deliveries, neither obstetrician nor pediatrician services necessarily available.
Secondary	24	0	Services available for moderate-risk deliveries, including an obstetrician or pediatrician, links to tertiary centers exist.
Secondary-modified	3	11	Most tertiary care services offered in a hospital with neither research nor teaching roles.
Tertiary	6	45	Resources for high-risk deliveries and neonatology subspecialty care.
Tertiary - modified	3	41	Tertiary services plus neonatal surgery and additional subspecialties.

SOURCE Gouvernemen du Quebec, Ministere de la Sante et des Services sociaux, "La Neonatalogie au Qu'ebec, " Rapport du groupe de travail, Quebec, 1992

Three Canadian centers offer ECMO services, located in university hospitals in Montreal, Toronto, and Edmonton. (A fourth, in British Columbia may be established shortly.) Each center has pursued a slightly different strategy to finance the equipment, training, and infrastructure support necessary to establish ECMO services.

Given the not insubstantial resources required for ECMO services, a request for funds to establish a new service was initially forwarded to the Quebec Ministry of Health and Social Services (MSSS) in 1988. The proposal identified an opportunity to reduce neonatal mortality and morbidity resulting from persistent pulmonary hypertension of the newborn (PPHN)—and also to reduce both short-term costs, by shortening intensive care stays; and long-term costs, by reducing morbidity and risks of cerebral and pulmonary injury (97).

The program's advocates estimated the potential annual demand to be 30 to 40 newborns in the province of Quebec. The MSSS responded with an initial grant of $50,000 for equipment purchase. In 1990 the hospital submitted a further request for funds to establish the clinical service that was 50 percent lower than the original amount. This reduction was attributed to a staff reorganization, a lowering of the estimated number of patients, and reduced equipment expenses, as some of the equipment had already been acquired.

To build support for the ECMO program, officials at the hospital needed to balance the need for sufficient publicity to further their cause with the need to avoid offending Montreal's other children's hospital, whose staff was not convinced of ECMO'S value. This became particularly important with respect to the issue of treating congenital diaphragmatic hernias (CDH). Advocates of ECMO point to its usefulness in newborns with CDH, arguing that respiratory stabilization prior to surgery should increase survival. Opinions regarding ECMO were not, however, uniform; physicians at other children hospitals made efforts to alert key government decisionmakers to the results of treating CDH with immediate surgery (37).

Further input to the decisionmaking process came from a CETS report entitled "ECMO: Efficacy and Potential Need in Quebec" (29). Given uncertain estimates of potential demand, the ministry asked CETS to investigate this technology and its potential role in the provincial health care system. The report advised the MSSS on criteria to use, should the decision be made to establish an ECMO unit in Quebec. The criteria addressed four key issues:

1. If ECMO services were to be provided, no more than one center should be opened.
2. This center should be located in a university teaching hospital with demonstrated research capability.
3. Prior to establishment, the designated center should submit a research proposal to provide policy-relevant information for decisionmaking on ECMO'S future in Quebec.
4. The designated center's program should be considered provisional, with continued operation conditional both on satisfactory functioning and on regular provision of the information identified above.

Ongoing uncertainty regarding potential demand in Quebec led CETS to conclude that ECMO, if brought into Quebec, should be introduced for the purpose of evaluation. In this way, needs for further information and advocates' desires to establish the service could be addressed by a single decision.

These efforts culminated in the June 1991 announcement of a budget supplement of $100,000 for the ECMO program at the Montreal Children's Hospital. In the first year, 18 children were treated with ECMO; 11 survived, and one was being treated at the time of data collection. Evaluation of the service is currently under way for submission to the MSSS.

In reconstructing the decisionmaking process, the role played by a strong incentive to act—namely, the cost of sending infants to the United States for ECMO treatment—looms large. In the year preceding the CETS report, this cost was said to have reached $700,000 for four children. The CETS report notes that "the transfer of as few as 3 patients per year for treatment outside the province...would be a significant financial outlay" (29). Cost estimates vary, but costs concerned all parties to the decisionmaking process.

The Quebec experience with ECMO reveals several key themes. First, the role of the technology assessment body appears to have been driven primarily by uncertainty about demand, efficacy, and economic concerns about alternatives to ECMO; establishing an ECMO service in Quebec offered the chance both to evaluate a new technology and to reduce overall expenditures on neonatal intensive care (through elimination of out-of-province transfers). Second, the conditions of the government's decision to implement a new service suggest strong influence by the CETS report. Third, the timeframe of decisionmaking was such that multiple consultations and iterations occurred between the government and the hospital involved.

As ECMO use increases in Canada, addressing quality-of-life issues for treated individuals and their families will become more important. More generally, a key issue for policymakers in Quebec and Canada will be the extent to which resources should be allocated to saving babies with ever-lower birthweights through technology-intensive care versus using those resources to prevent prematurity and low birthweight.

SCREENING FOR BREAST CANCER

Screening for breast cancer, primarily involving mammography and breast self-examination, has been and continues to be a high-profile issue in Canada. Both federal and provincial governments have developed policies and programs and several reports and resource documents have attempted to bring scientific data into decisionmaking.

A useful point of departure for investigating Canadian approaches to breast cancer screening is the National Breast Screening Study (NBSS). This multicenter, randomized trial began in 1980 (95); despite some initial difficulties, 89,835 women were enrolled (4). In 1992, the investigators reported their results for women from 40 to 49 years old at enrollment and for women from 50 to 59 at enrollment (92,93). Previous publications had addressed the operating characteristics of first-screening mammography and of physical examination, improvements in technical quality, and the role of nurse-examiners in breast cancer screening (5,6,7,94). Among the women enrolled in the NBSS at ages 40 to 49, the strategies compared were usual care and the screening combination of annual mammography and physical examination. After a mean followup of 8.5 years,

no difference in death rates from breast cancer was found. The investigators reported increased numbers of node-negative, small tumors in the screened women compared to the women receiving usual care (92).

Women aged 50 to 59 at enrollment were randomized to either annual mammography and physical examination or annual physical examination alone. After a mean followup of 8.3 years, no difference in death rates from breast cancer was found; however, as with women aged 40 to 49, increased numbers of small, node-negative tumors were reported among the women undergoing annual mammography (93).

The NBSS will continue to provide valuable data for scientists and policymakers. However, political pressure has required Canadian provincial governments to act prior to the NBSS data becoming available. Breast cancer screening was discussed at several meetings of the Conference of Deputy Ministers of Health and led to the publication of a federal report in 1986 outlining desirable standards for screening mammography, a 1988 federal-provincial workshop, and a December 1988 implementation report in which all provinces agreed to make breast cancer screening a priority (16,39,70,125).

British Columbia was the first province to establish a formal screening mammography program. Other provinces soon followed suit with variations on a general pattern of pilot-phase projects with provision for expansion to province-wide programs. Although scientific data clearly played a significant role in policy formation, technology assessment of breast cancer screening approaches in Canada had been fairly small scale. The 1988 workshop report had provided an preview of the scientific data including the HIP study and studies in Sweden, Haly, The Netherlands, and preliminary results from the NBSS (38,103,1 10,121 ,124).

To date, two technology assessment bodies have addressed screening for breast cancer. The Canadian Coordinating Office for Health Technology Assessment published a brief commentary on a selection of trials of breast cancer screening programs in 1992 (23). This appears to have been prompted by a request for information from one or more provinces. Despite general agreement on the efficacy and political importance of mammography programs, much heated debate has continued on the question of who should be screened and at what frequency.

In Quebec CETS published a report in 1990 entitled “Screening for Breast Cancer in Quebec: Estimates of Health Effects and of Costs.” Drawing on efficacy data from a number of trials of breast cancer screening programs, the report concluded that “there is solid evidence that it is possible to prolong the life of women with breast cancer through early detection by periodic screening using mammography, with or without physical examination” (31). The report estimated that universal participation among women aged 50 to 69 in a biennial screening program would cost approximately $27 million annually. More realistic estimates of 75 and 60 percent participation would yield annual direct costs of $20 million and $16 million, respectively. Estimates of expenditures per life-year gained ranged from $3,400 to $5,700, depending on participation levels required to realize projected aggregate increases in life expectancy. Recognizing that mammography was already in widespread use in Quebec, the report also recommended steps to optimize screening activities already under way, including possible targeting of mammography to women of selected ages.

Throughout the last decade, the number of mammograms performed in Quebec increased, reaching 337,050 in 1991; however, fully 53 percent of these were for women less than 50 or more than 69 years of age. Approximately two-thirds of these examinations were done in clinics and the remainder in hospitals. Despite this growth, pressure to establish dedicated breast cancer screening centers rose with the end of enrollment in the NBSS and the subsequent closure of study centers in 1987. The health Minister at the time announced that no decision would be made until the results of the NBSS were available, expected to be in 1990. Meanwhile, pressure for action grew and *was* mirrored by the high priority given to screen-

ing mammography at the 1988 federal-provincial conference.

In July 1989 a proposal was made to the government for 37 designated screening centers across the province to establish a biennial mammography program for women aged 50 to 69. Costs were estimated at $9 million but would be offset by savings in breast cancer treatment costs resulting from early detection and the ending of screening mammograms described as "unnecessary" in women under 50 years of age. Part of this proposal directed CETS to examine the evidence on the efficacy of screening programs for breast cancer.

CETS released its report in January 1991, making recommendations on reimbursement for mammography, guidelines for screening programs, and data collection for program evaluation. During the following two months, the government endorsed the CETS recommendations, and the health Minister, expressing reservations about dedicated screening centers, advocated optimization of existing services.

A year later the provincial association of radiologists argued that screening mammograms should be available to women from 40 to 49 years old. This position generated a great deal of editorial comment, as it contradicted the views of the ministry and CETS. In June 1992, pressure on the health Minister increased with the presentation of a petition from Breast Cancer Action of Montreal calling for the reimbursement of physicians for screening mammograms in women 40 to 49 years old; however, by October this group had agreed with the idea of focusing on women aged 50 to 69. In May 1993 CETS published a report on breast cancer screening in women under 50 years of age and noted that data supporting a benefit of screening in this group were indirect and weak (34). However, CETS stated that technological advancements might well shift the balance in favor of screening women aged 40 to 49, and for this reason the case should not be considered closed. CETS concluded its report with an urgent call for policy on screening mammography in light of the not insignificant health and financial effects of the current situation.

Current government policy is to provide a universal mammography screening program for women from 50 to 59 years old. Younger women at higher risk because of family history of breast cancer will have access to screening following medical referral. This policy essentially follows the recommendations of CETS and includes provisions for optimization of existing resources, together with coordination and quality assurance mechanisms.

The Quebec experience with breast cancer provides insights into how technology assessment fits into a highly politicized health issue. With a visible and well-organized target constituency, policy development on breast cancer screening is far more delicate than on items such as MRI scanners. Various actors in the debate have used media sources to attempt to strengthen their positions, thrusting technology assessment into the glare of public attention.

Technology assessment seems to have weathered this quite well in Quebec, but in a largely reactive fashion. As technology assessment matures in Canada and is brought to bear on issues of increasing political importance, its practitioners may have to ask whether they will need to become more skilled in media relations and communications and if this will threaten scientific rigor and credibility. These demands may herald the formation of dedicated communication units or an important role for communications professionals within technology assessment organizations.

CETS also appears to have played an important role as an arbiter of sorts, providing the government with advice for policy and political breathing room. As difficult a balance as this role requires, it is likely to become more frequent as technology assessment matures.

CHAPTER SUMMARY

A decade ago OTA reviewed health technology management in a number of countries (8). At that time in Canada, management was marked by a rigid separation of roles: providers stated their needs and payers (provincial governments) decided whether to provide the requisite funds. Technology assessment was largely a theoretical proposition.

A decade later, much has changed. Cost concerns have broadened the focus of both groups, with payers increasingly interested in the effects of interventions and programs, and providers more concerned with costs. Evaluation has thus emerged as a common basis for sharing decisionmaking. Health technology assessment is now established, and its development has been further encouraged by information needs arising from a management framework in which providers and payers both increasingly demand the results of evaluation.

Several prominent themes emerge from our survey of health technology in Canada. The first is that diffusion patterns of technologies within the Canadian health care system are determined by the system's overall characteristics. Provider autonomy and fee-for-service remuneration have created a system responsive to emerging needs and emerging technologies, and central control and global budgeting provide levers for rational planning. Finally, public financing holds regulation increasingly accountable through the democratic process. Effective control of diffusion occurs rarely by '-magic bullet" but rather by creating a macro-level environment that acts to constrain micro-level choices.

For example, limiting funds available for acquiring expensive technologies is a macro-level decision effectively limiting the supply of these technologies at the provider level. The government does not bar physicians or hospitals from acquiring or using such technologies; rather, it creates boundaries within which acquisition or use occurs. In the case of CT scanners, a philanthropy-based macro-level policy acting to slow acquisition has had the intended effect of slowing diffusion in Quebec as compared with Ontario.

The Canadian experience demonstrates that there is nothing magic or sacred about health care technologies that makes them more or less amenable to regulation than other elements of the system. Instead, the system's structure creates decisionmaking schemes and incentives that collectively shape technology diffusion. Only at this macro level has the Canadian health system been able to influence diffusion, with greater influence as the resource intensity of the technology increases. In contrast, the rapid spread of laparoscopic cholecystectomy indicates that the system offers a great deal of flexibility for adopting less resource-intensive technologies. By not challenging the boundaries set at the macro level, these technologies have been free to diffuse unchecked by measures explicitly directed at them.

Given the need for and impact of a comprehensive strategy, a basic question arises: how did this framework come to be? The levers of control of the Canadian health care system have been in place for over 20 years but have only recently been used firmly. The spur to action comes from increasing demands for more resource-intensive services from an increasingly older population, creating both the need and the incentive to curtail costs.

In the face of this pressure, a comprehensive strategy was not implemented all at once; existing elements of the system including global budgets and bed controls for hospitals, policies regarding physician numbers and remuneration, regionalization, capital expenditures, and insured services provided policymakers with a series of complementary levers. With cost concerns, preexisting synergies simply became apparent and were more effectively deployed.

In this vein Quebec may have been slightly ahead of the rest of the country. A cultural receptiveness to systems planning exists in Quebec that is less evident in predominantly English-speaking provinces. Given the strong ties of culture and language among the people of Quebec, the threshold

for widespread physician resistance may be higher there than in the rest of the country, where physician migration appears more likely.

Turning to the technologies considered in this chapter, the ability of the system to temper diffusion may well have been helped by the lack of evidence of adverse outcomes attributable to a limited supply of health care technologies such as MRI. For life-saving technologies (e.g., therapies for ESRD) a hands-off, macro-level approach is less possible, and specific and sporadic adjustments are made in light of changing needs.

More troubling, the system has also been free from accountability for the quality of care dispensed. The Canadian model of using system features as levers to control technology diffusion has been reasonably successful at the macro level, particularly regarding "high-tech" acquisitions, but does not necessarily result in the greatest efficiency. Thus, a final theme is the challenge, in the face of continued cost pressure, to design and implement effective mechanisms that will optimize use and address practice.

The fundamental principles of the Canadian health care system—universality, portability, and comprehensiveness—are coming under increasing scrutiny. Global budgeting and acquisition controls have limited aggregate expenditures, but some combination of regulation, incentives, information, and education will be necessary to ensure appropriate utilization of technologies. Addressing this micro level will require new approaches to complement existing mechanisms and may well include clinical practice guidelines for practitioners and scrutiny of existing incentives favoring adoption, diffusion, and use of technologies at the practitioner level.

To date, physician organizations, particularly the Canadian Medical Association, have attempted to claim guidelines as a matter to be developed within the profession. This appears consistent with the system's traditional role definitions. The patience of governments, in their role as payers, may soon be tested if actual guidelines continue to diffuse at their current slow rate. Nevertheless, an increasing role for practice-focused technology assessment appears inevitable. Changing perceptions of the role of the physician, coupled with increasing demands by citizens for both efficiency and high-quality care, cannot help but promote technology assessment as a vehicle for resolving the inherent conflict between these two demands. In this light, technology assess: ment's task of bridging science and policy remains paramount; however, increasing emphasis on communication—particularly new methods of intervention and incentives for information use, may well expand current notions of what a technology assessment body does.

Despite this potential for expansion, practice-focused technology assessment will share with its procurement-focused counterpart needs for rigorous methods and ongoing vigilance to ensure that policy-relevant information is produced. As with procurement, there will be no "magic bullet" to improve quality of care and user satisfaction; rather, the structural features of the system within which care is delivered will bean important determinant of its quality. The challenge for technology assessment in Canada is to deliver information that enhances efficiency and quality in a system that is based on a balance among fiscal control, consumer choice, and provider autonomy.

REFERENCES

1. Anderson, G. M., and Lomas, J., "Monitoring the Diffusion of a Technology: Coronary Artery Bypass Surgery in Ontario," *Am. J. Public Health 78:251-254, 1988.*
2. Anderson, G. M., Grumbach, K., Luft, H. S., et al., "Use of Coronary Artery Bypass Surgery in the United States and Canada," *J.A.M.A. 269: 1661-1666, 1993.*
3. Andreopoulos S., (cd.) *National Health Insurance: Can We Learn from Canada? (New* York: John Wiley, 1975).
4. Baines, C.J., ● 'Impediments to Recruitment in the Canadian National Breast Screening Study: Response and Resolution," *Controlled Clin. Trials 5: 129-140, 1984.*
5. Baines, C. J., Miller, A. B., and Bassett, A. A., "Physical Examination. Its Role as a Single Screening Modality in the Canadian

National Breast Screening Study," *Cancer* 63: 1816-1822, 1989.

6. Baines, C. J., Miller, A. B., Kopans, D. B., et al., "Canadian National Breast Screening Study: Assessment of Technical Quality by External Review," *Am. J. Roentgenol. 155: 743-747, 1990.*
7. Baines, C.J., Miller, A. B., Wall, C., et al., "Sensitivity and Specificity of First Screen Mammography in the Canadian National Breast Screening Study: a Preliminary Report from Five Centres," *Radiology 160:295-298, 1986.*
8. Banta, H. D., and Kemp, K. B., (eds.) *Management of Health Care Technology in Nine Countries (New* York, NY: Springer, 1982).
9. Banta, H. D., and Sanes, J. R., "How the CAT Got Out of the Bag," *Technology and the Quality of Health Care,* R.H. Egdahl and P.M. Gertman (eds.) (Germantown, MD: Aspen Systems Corp., 1978).
10. Barer, M.L, and Stoddart, G. L., "Toward Integrated Medical Resource Policies for Canada," report prepared for the Conference of Deputy Ministers of Health, June 1991.
11. Baris, E., and McGregor, M., "The Reuse of Hemodialyzers: an Assessment of Safety and Potential Savings," *Can. Med. Assoc. J.* 148: 175-183, 1993.
12. Barkun, J. S., Barkun, A. N., Sampalis, J. S., et al., "Randomised Controlled Trial of Laparoscopic versus Mini Cholecystectomy," *Lancet 340:11* 16-1119, 1992.
13. Battista, R. N., "Innovation and Diffusion of Health-Related Technologies," *lnt. J. Tech. Assess. Health Care 5:227-248, 1989.*
14. Battista, R. N., Feeny, D. H., and Hedge, M. J., "Evaluation of the Canadian Coordinating Office for Health Technology Assessment," *Int. J. Tech. Assess. Health Care,* in press, 1994.
15. BCOHTA-British Columbia Office of Health Technology Assessment, presentation notes, 1992.
16. Campbell, H. S., *The Impact of Science on Policy Initiation: Breast Cancer Screening in Four Canadian Provinces,* Ph.D. Thesis, University of North Carolina at Chapel Hill, 1990.
17. Canadian Consensus Conference on Cholesterol, "Final Report: The Canadian Consensus Conference on the Prevention of Heart and Vascular Disease by Altering Serum Cholesterol and Lipoprotein Risk Factors," *Can. Med. Assoc. J.* 139(suppl): 1-8, 1988.
18. Canadian Erythropoietin Study Group, "Association Between Recombinant Human Erythropoietin and Quality of Life and Exercise Capacity of Patients Receiving Haemodialysis," Br. *Med. J.* 300:573-577, 1990.
19. Canadian Medical Association, *Proceedings of the Workshop on Clinical Practice Guidelines* (Ottawa: 1993).
20. Canadian Organ Replacement Register, 1991 *Annual Report* (Don Mills, 1993).
21. Canadian Task Force on the Periodic Health Examination, "The Periodic Health Examination," *Can. Med. Assoc. J.* 121: 1193-1254, 1979.
22. CCOHTA-Canadian Coordinating Office for Health Technology Assessment, *Annual Report 1991-1992* (Ottawa: 1992).
23. CCOHTA-Canadian Coordinating Office for Health Technology Assessment, *An Over-view of Major Breast Screening Studies and their Findings* (Ottawa: CCOHTA, 1992).
24. CCOHTA-Canadian Coordinating Office for Health Technology Assessment, *Technology Brief No. 5.1* (Ottawa: 1993).
25. CCOHTA-Canadian Coordinating Office for Health Technology Assessment, *Technology Brief, No. 5.3* (Ottawa: 1994).
26. Cernetig, M., "Health-Care Clinics Taking U.S. Twist," *Globe & Mail,* Apr. 10, 1993, p. 1 (col. 1).
27. CETS-Conseil d'e'valuation des technologies de la sante' du Quebec, *Distribution of Cardiac Catheterization Laboratories in Quebec* (Montreal: CETS. 1989).

28. CETS-Conseil d'évaluation des technologies de la santé du Québec, *Mandate and Organization* (Montreal: CETS, 1989).
29. CETS-Conseil d'évaluation des technologies de la santé du Québec, *ECMO: Efficacy and Potential Need in Quebec* (Montreal: CETS, 1990).
30. CETS-Conseil d'évaluation des technologies de la santé du Québec, *Magnetic Resonance Imaging* (Montreal: CETS, 1990).
31. CETS-Conseil d'évaluation des technologies de la santé du Québec, *Screening for Breast Cancer in Quebec: Estimates of Health Effects and Costs* (Montreal: CETS, 1990).
32. CETS-Conseil d'évaluation des technologies de la santé du Québec, *Reuse of Hemodialyzers: Efficacy, Safety, Costs* (Montreal: CETS, 1991).
33. CETS-Conseil d'évaluation des technologies de la santé du Québec, *Transplantation in Quebec* (Montreal: CETS, 1991).
34. CETS-Conseil d'évaluation des technologies de la santé du Québec, *Breast Cancer Screening Among Women 40-49* (Montreal: CETS, 1993).
35. CETS-Conseil d'évaluation des technologies de la santé du Québec, *Treatment of Gallbladder Disease by Conventional Cholecystectomy, Laparoscopic Cholecystectomy, Extracorporeal Lithotripsy. A Cost Comparative Study* (Montreal: CETS, 1993).
36. CETS-Conseil d'évaluation des technologies de la santé du Québec, *Les Variations Géographiques clans le Taux des Interventions Chirurgicales au Québec* (Montreal: CETS, 1993).
37. Cloutier, R., et al., "La Hernie Diaphragmatique Congénitale-Réévaluation Thérapeutique," *Chir. Pediatr.* 30:6-9, *1989.*
38. Collette, H. J. A., Day, N. E., Rombach, J.J., et al., "Evaluation of Screening for Breast Cancer in a Non-Randomised Study (The Dom Project) by Means of a Case-Control Study," *Lancet* i: *1224-1226, 1984.*
39. Conference of Deputy Ministers of Health, "Reducing Deaths from Breast Cancer in Canada," report of a workshop on the early detection of breast cancer sponsored by Health and Welfare Canada, The Canadian Cancer Society, and The National Cancer Institute of Canada (Ottawa: 1988).
40. Contandriopoulos, A. P., "Cost Containment Through Payment Mechanism: The Quebec Experience," *Journal of Public Health Policy,* 7:21 *1-217, 1986.*
41. Deber, R. B., Thompson, G. G., and Leatt, P., "Technology Acquisition in Canada," *Int. J. Tech. Assess. Health Care* 4: *185-206, 1988.*
42. Department of Health Care and Promotion, Canadian Medical Association, "Workshop on Clinical Practice Guidelines: Summary of Proceedings," *Can. Med.* Assoc. *J.* 148: 1459-1462, 1993.
43. Dion, Y., and Morin, J., "Laparoscopic Cholecystectomy: a Report of 60 Cases," *Can. J. Surg.* 33:483-486, *1990.*
44. Dion, Y., and Morin, J., "Laparoscopic Cholecystectomy: a Review of 258 Patients," *Can. J. Surg.* 35:317-320, 1992.
45. Donabedian, A., "The Assessment of Technology and Quality: A Comparative Study of Certainties and Ambiguities, " *Int. J. Tech. Assess. Health Care* 4:487-496, *1988.*
46. *Evaluation du Conseil devaluation des Technologies de la Santé*, rapport de Price Waterhouse préparé à la demande du Ministère de la Santé et des Services sociaux (Québec: MSSS, Direction de I 'Evaluation, 1991).
47. Evans, R.G., "The Fiscal Management of Medical Technology: The Case of Canada," *Resources for Health-Technology Assessment for Policy Making,* H.D. Banta (cd.) (New York, NY: Praeger, 1982).
48. Evans, R. G., "Public Health Insurance: The Collective Purchase of Individual Care," *Health Policy,* 7: *115-134, 1987.*
49. Evans, R. G., et al. "Controlling Health Expenditures—The Canadian Reality," N. *Engl. J. Med.,* 320:571-7,1989.

50. Federal/Provincial Task Force, "Report to the Conference of Deputy Ministers of Health on a Canadian Agency for Pharmaceutical Information Assessment (National Formulary Service)," Dec. 4, 1992.

51. Feeny, D., and Stoddart, G., "Toward Improved Health Technology Policy in Canada: A Proposal for the National Health Technology Assessment Council," *Can. Pub. Policy X1* V:254, *1988.*

52. Girotti, M. J., "Minimal Access Surgery: Laparoscopic Cholecystectomy," *Annals RCPSC* 24:377-379, *1991.*

53. Girotti, M. J., Nagy, A. G., Litwin, D. E. M., et al., "Symposium on Laparoscopic Surgery 4. Laparoscopic Surgery—Basic Armamentarium," *Can. J. Surg.* 35:281-284, 1992.

54. Gouvernement du Quebec, Régie de l'assurance-maladie, *Effet des Modifications a l'Entente sur la Dispensation des Injections de Substances Sclérosantes*, Québec, 1976.

55. Gouvemement du Quebec, Ministère de la Sante et des Services sociaux, "L'imagerie Médicale au Québec," rapport d'une recherche sur le phénomène de diffusion des technologies médicales, Quebec, 1986.

56. Gouvemement du Quebec, *Rapport de la Commission d'Enquête sur les Services de Santé et les Services Sociaux* (Québec: 1988).

57. Gouvemement du Quebec, Ministère de la Santé et des Services sociaux, "Etude sur les Laboratoires de Catheterisme Cardiaque au Québec," document de travail, Québec, September 1988 rev, January 1989.

58. Gouvemement du Québec, Ministère de la Sante et des Services sociaux, "Les Services Tertiaires en Cardiologies," rapport du groupe de travail sur la revascularisation coronarienne, Quebec, June 1990.

59. Gouvernement du Québec, Ministère de la Sante et des Services sociaux, "Elements de Planification—Diffusion de l'Imagerie par Resonance Magnétique—Aspects Régionaux et Provincial," Québec, July, 1991.

60. Gouvemement du Québec, Ministère de la Santé et des Services sociaux, "Un Financement Equitable a la Mesure de nos Moyens," Québec, 1991.

61. Gouvemement du Québec, Régie de l'Assurance-Maladie, *Liste de Médicaments*, (Québee, 1991).

62. Gouvemement du Québec, "Les Services aux Personnes au Stade Terminal de 1'Insuffisance Rénale: Problématique, État de 1a Situation et Proposition d'Organisation pour 1991 -1996," version préliminaire et document de travail, (Québec, 1991).

63. Gouvemement du Québec, Ministère de la Santé et des Services sociaux, "Gestion de l'Accessibility aux Services de Cardiologie Tertiaire," rapport du groupe de travail - document de travail, Québec, May 1992.

64. Gouvemement du Québec, Ministère de la Santé et des Services sociaux, "La Néonatalogie au Québec," Rapport du groupe de travail, Québec, 1992.

65. Gouvemement du Québec, Régie de l'assurance-maladie, *Statistiques Annuelles, 1991,* Québec, 1992.

66. Government of Canada, *Royal Commission on Health Services* (Ottawa: 1964).

67. Government of Canada, *Direction for Change,* report of the Medical Devices Review Committee (Ottawa: 1992).

68. Government of Ontario, Ministry of Health, "Report of the Task Force on the Placement Tomography," Toronto, Feb. 26, 1976.

69. Government of Quebec. Reform Centred on Citizens. Ministry of Health, Quebec City, 1990.

70. Health and Welfare Canada, "Breast Imaging Services: Mammography," a report to the Advisory Committee on Institutional and Medical Services, (Ottawa: 1986).

71. Health and Welfare Canada, 1984-85 *Canada Health Act. Annual Report* (Ottawa: 1986).

72. Hospital Services Branch, Saskatchewan Health, "Laparoscopic Cholecystectomy,"

report prepared for the Technology Advisory Committee, January, 1991.
73. Iglehart, J. K., "Canada's Health Care System Faces its Problems," N. *Engl. J. Med.*, 322:562-568, *1990.*
74. Institute of Medicine, *Assessing Medical Technologies,* (Washington, DC: National Academy Press, 1985).
75. Jacob, R., *L'Imagerie Médicale au Québec*, rapport d'une recherche sur le phénomène de diffusion des technologies médicales, Direction générale de I 'evaluation et de la planification, ministère de la Santé et des Services sociaux, (Québec: 1986).
76. Jacob, R., Quebec Ministry of Health and Social Services, personal communication, 1994.
77. Jacob, R., and Battista, R. N., "Assessing Technology Assessment: Early Results of the Quebec Experience, "*Int. J. Tech. Assess. Health Care,* 9(4):564-572,1993.
78. Jeffrey, J. R., Arbus, G. S., Hutchinson, T., et al., "Renal Transplantation in Canada from 198 1-86: Report of the Canadian Renal Failure Register," *Transplantation Proceedings* 21:2171-2173, *1989.*
79. Katz, S.J., Mizgala, H. F., and Welch, H. G., "British Columbia Sends Patients to Seattle for Coronary Artery Surgery," *J.A.M.A. 266:* 1108-1111, 1991.
80. Keith, R. G., "Laparoscopic Cholecystectomy: Let Us Control the Virus," *Can. J. Surg.* 33:435-436, 1992.
81. Keown, P. A., "Recombinant Human Erythropoietin and Renal Transplantation," *Semin. Nephrol.* 10 S 1 :52-58, 1990.
82. Klazinga, N., "Technology Assessment and Quality Assurance," paper presented at the 1990 ISTAHC Conference, Houston, May 21, 1990.
83. Lalonde, M. *A New Perspective on the Health of Canadians* (Ottawa: Government of Canada, Department of Health and Welfare, 1975).
84. Litwin, D. E. M., Girotti, M. J., Poulin, E. C., et al., "Symposium on Laparoscopic Surgery 6. Laparoscopic Cholecystectomy: Trans-Canada Experience with 2201 Cases," *Can. J. Surg.* 35:291-296, 1992.
85. Lomas, J., Anderson G. M., Domnick-Pierre, K., et al., "Do Practice Guidelines Guide Practice?" N. *Engl. J. Med.* 321:1306-1311, *1989.*
86. Manga, P., Broyles, R. W., and Angus, D. C., "The Determinants of Hospital Utilization Under a Universal Public Insurance Program in Canada," *Med. Care.* 25:658-670, 1987.
87. Marshall, D., and Menon, D., "Laparoscopic Cholecystectomy Diffusion in Canada," abstract presented at ISTAHC Conference, Vancouver, June 1992.
88. Marshall, D., Clark, E., and Hailey, D., "'The Impact of Laparoscopic Cholecystectomy in Canada and Australia," paper presented at the Ninth Annual Meeting of ISTAHC, Sorrento, May 1993.
89. McGlynn, E. A., Kosecoff, J., and Brook, R. H., "Format and Conduct of Consensus Development Conferences—Multination Comparison," *Int. J. Tech. Assess. Health Care 6: 450-469, 1990.*
90. McGregor, M., David, P., Lemieux, M., et al., "Comité d'Étude sur l'Hemodynamie et la Chirurgie Cardiaque," rapport déposé au Ministère des Affaires sociales du Quebec, Québec, Oct. 4, 1977.
91. Menon, D., and Marshall, D., "Diffusion of Laparoscopic Cholecystectomy in Canada," manuscript in preparation, 1994.
92. Miller, A. B., Baines, C.J., To, T., et al., "Canadian National Breast Screening Study: 1. Breast Cancer Detection and Death Rates Among Women Aged 40 to 49 years," *Can. Med. Assoc. J.* 147: 1459-1476, 1992.
93. Miller, A. B., Baines, C. J., To, T., et al., "Canadian National Breast Screening Study: 2. Breast Cancer Detection and Death Rates among Women Aged 50 to 59 Years," *Can. Med. Assoc. J.* 147: 1477-1488, 1992.
94. Miller, A. B., Baines, C.J., and Turnbull, C., "The Role of the Nurse-Examiner in the Na-

tional Breast Screening Study," *Can. J. Public Health 82: 162-167, 1991.*

95. Miller, A. B., Howe, G. R., and Wall, C., "The National Study of Breast Cancer Screening-Protocol for a Canadian Randomized Controlled Trial of Screening for Breast Cancer," *Clin. Invest. Med.* 4:227-258, *1981.*

96. Ministère de la Santé et du Bien-être social du Canada, *Services Cardio-vasculaires clans les Hôpitaux. Directives pour l'Établissement de Normes Régissant les Services Spéciaux dans les Hôpitaux* (Ottawa: 1977).

97. Montreal Children's Hospital, proposal submitted to Ministère de la Sante et des Services sociaux, 1988.

98. Morris, A. L., Roos, L. L., Brazauskas, R., et al., "Managing Scarce Services a Waiting List Approach to Cardiac Catheterization," *Med. Care* 28:784-792, 1990.

99. Muirhead, N., Laupacis, A., and Wong, C., "Erythropoietin for Anaemia in Haemodialysis Patients: Results of a Maintenance Study," *Nephrol. Dial. Transplant.* 7:81*1-816, 1992.*

100. Nagy, A. G., Poulin, E. C., Girotti, M.J., et al., "Symposium on Laparoscopic Surgery 2. History of Laparoscopic Surgery," *Can. J. Surg.* 35:271-274, 1992.

101. Naylor, C. D., "A Different View of Queues in Ontario," *Health Aff.* 10(1): 110-128, 1991.

102. Ontario Health Review Panel, *Toward a Shared Direction for Health in Ontario* (Toronto: 1987).

103. Palli, D., Del Turco, M. R., Buiatti, E., et al., "A Case-Control Study of the Efficacy of a Non-Randomized Breast Cancer Screening Programme in Florence (Italy)," *Int. J. Cancer* 38:501-504, 1986.

104. Poulin, E. C., "Symposium on Laparoscopic Surgery 1. Opening Remarks," *Can. J. Surg.* 35:269, 1992.

105. Poulin, E. C., Mamazza, J., Litwin, D. E. M., et al., "Symposium on Laparoscopic Surgery 5. Laparoscopic Cholecystectomy: Strategy and Concerns," *Can. J. Surg.* 35:285-289, 1992.

106. Province of British Columbia, *Closer to Home The Report of the British Columbia Royal Commission on Health Care and Costs* (Victoria: 1991).

107. Rublee, D. A., "Medical Technology in Canada, Germany and the United States," *Health Aff.* 3:178-181, *1989.*

108. Schieber, G.J., and Poullier, J. P., "International Health Spending: Issues and Trends," *Health Aff.* 10: 106-116, 1991.

109. Scheiber, J. S., Poullier, J. P., and Greenwald, L. M., "Health Care Systems in Twenty-four Countries," *Health Aff.*10:22-38, *1991.*

110. Shapiro, S., Strax, P. H., and Venet, L., "Periodic Breast Cancer Screening in Reducing Mortality from Breast Cancer," *J.A.M.A.* 215:1771-1785, *1971.*

111. Sheingold, S., Churchill, D., Muirhead, N., et al., "The Impact of Recombinant Human Erythropoietin on Medical Care Costs for Haemodialysis Patients in Canada," Soc. *Sci. Med.* 34:983-991, 1992.

112. Statistics Canada, Institutional Care Statistics Division, *Hospital Morbidity 1981, 1989*, Statistics Canada Pub. No. 82-206 (Ottawa: 1983 and 1991).

113. Statistics Canada, Vital Statistics and Disease Registries Section, *Causes of Death, 1981,1989*, Statistics Canada Pub. No. 84-203 (Ottawa: 1983 and 1991).

114. Statistics Canada, *Hospital Morbidity 1989-90*, Statistics Canada Pub, No. 82-003S1 (Ottawa: 1992).

115. Statistics Canada, *Leading Causes of Death at Different Ages, Canada, 1990,* Statistics Canada, Canadian Centre for Health Information (Ottawa: 1992).

116. Statistics Canada, *Live Births, 1990,* Statistics Canada Pub. No. 82-003S15 (Ottawa: 1992).

117. Statistics Canada, *Immigration and Citizenship,* Statistics Canada Pub. No. 93-316 (Ottawa: 1993).

118. Statistics Canada, *Knowledge of Languages,* Statistics Canada Pub. No. 93-318 (Ottawa: 1993).
119. Statistics Canada, *The Nation: Age, Sex, and Marital Status,* Statistics Canada Pub. No. 93-310 (Ottawa: 1993).
120. Strasberg, S. M., Sanabria, J. R., and Clavien, P. A., "Symposium on Laparoscopic Surgery 3. Complications of Laparoscopic Cholecystectomy," *Can. J. Surg.* 35: 275-280, 1992.
121. Tabar, L., Fagerberg, C.J.G., Gad, A., et al., "Reduction in Mortality from Breast Cancer after Mass Screening with Mammography," *Lancet* i:829-832, 1985.
122. Taylor, M. G., *Health Insurance and Canadian Public Policy* (Montreal: McGill-Queens Press, 1978).
123. U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health, "Breast Cancer Screening," *NIH Consensus Development Conferences Summaries 1977-1978* 1:3-5, *1978.*
124. Verbeek, A. L. M., Hendriks, J. H. C. L., Holland, R., et al., "Mammographic Screening and Breast Cancer Mortality: Age-specific Effects in Nijmegan Project, 1975 -82," *Lancet* i:865-866, 1985.
125. The Working Group, "Reducing Deaths from Breast Cancer in Canada," *Can. Med. Assoc. J.* 141: 199-201, 1989.
126. World Health Organization, *World Health Statistics Annual 1992* (Geneva: WHO, 1993).
127. Young, T. K., Kaufert, J. M., McKenzie, J. K., et al., "Excessive Burden of End-Stage Renal Disease among Canadian Indians: a National Survey," *Am. J. Publ. Health* 79:756-758, *1989.*