Population Health and Health Care Use: An Information System for Policy Makers

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DESPITE ENORMOUS INVESTMENTS IN FIGHTING cancer and pressures to put more resources into expensive diagnostic techniques and costly drugs, the relation between health care spending and the health of populations remains weak at best (Charlton et al. 1983). Historically, allocations for hospital services have been made in response to population growth, increases in volume of use, technological imperatives, and political pressure. The numbers and specialties of physicians and their practice locations have seldom been linked to the health needs of populations. Critical assessments of care typically focus on the clinical outcomes of individual treatments and the quality of care delivered by institutions, not on the health of populations.

Publicly funded systems require tools to help policy makers make assessments and respond to questions from the public like the following:

1. What are the levels of health in different regions?
2. What is the level of investment per capita in acute care for different areas?

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3. Are high-risk populations poorly served or do they have poor health outcomes despite being well served?
4. Does high utilization represent overuse or utilization related to high need?
5. Does high need respond positively to added health care resources?
6. Where might financial cuts be made without jeopardizing "at risk" populations?
7. What is the appropriate level of various kinds of health care resources in a given region?

We have developed a population health information system (POPULIS) to help the public understand that more health care is not necessarily better and to help planners identify the levers for combining the concerns of population health and cost containment.

POPULIS facilitates a comparison of the health characteristics of regional populations and how they use the health care system. This information system builds on administrative data generated while paying hospitals, nursing homes, and physicians. The system is able to document anomalies and encourage the development of policy for improving population health. We believe the principles underlying this system to be applicable elsewhere. This article describes our approach and its application in one health care jurisdiction: the province of Manitoba, Canada. The quality and the utility of the Manitoba data for addressing important questions in health services research have been discussed at length elsewhere (L.L. Roos et al. 1982; N.P. Roos 1989).

Critical Concepts

Our conceptual model (fig. 1) expands upon one proposed by Evans and Stoddart (1990). It combines a range of background factors that, influenced by individual responses, lead to initial health status and well-being. Health status, again mediated by individual responses, affects demand for health care services; utilization is jointly determined by supply and practice pattern factors. The individual response to care leads to a new outcome: a subsequent health status and level of well-being that feeds back into the model iteratively.

Not too long ago the world appeared much simpler. We assumed that use of the health care system was largely determined by ill health and

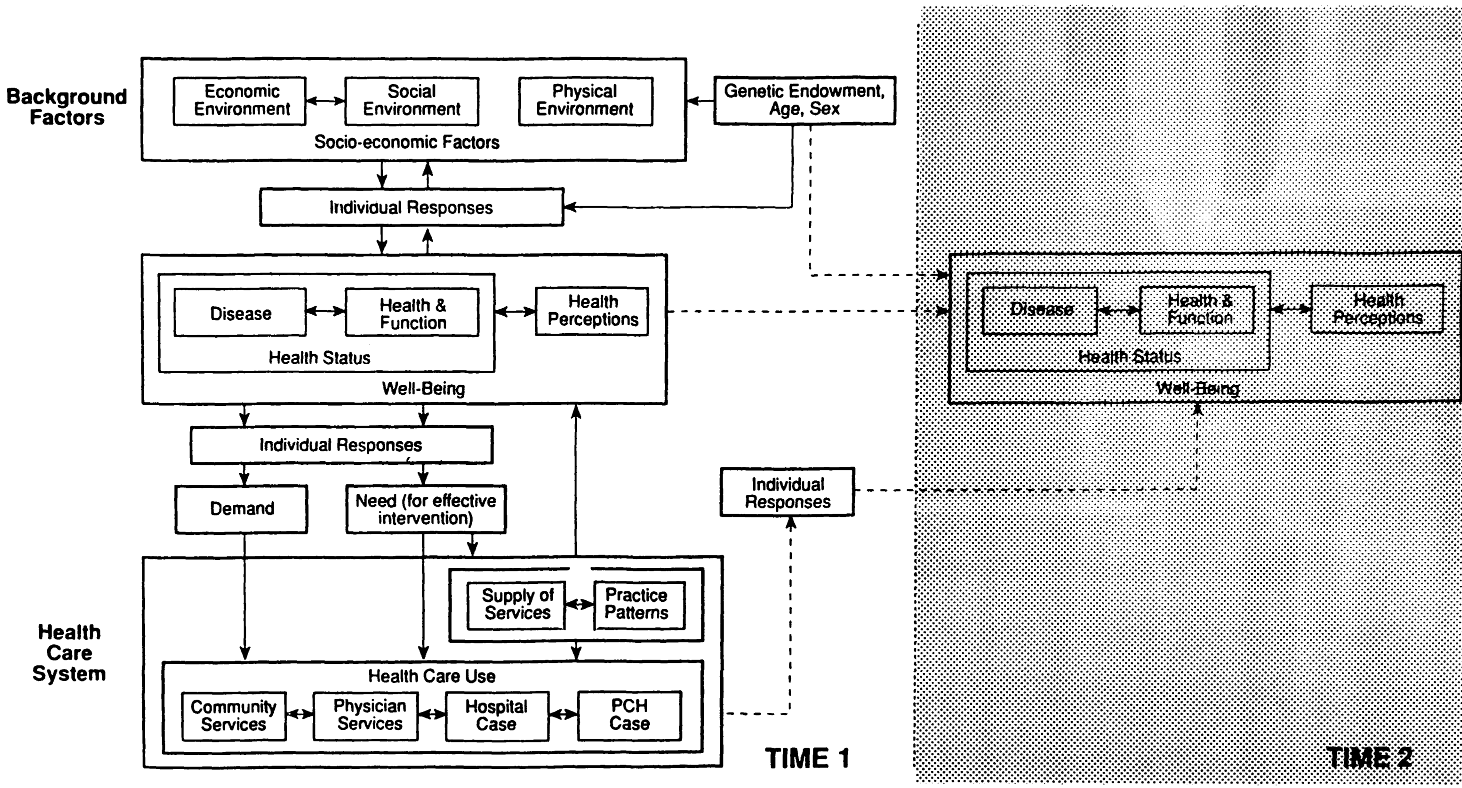

FIG. 1. The conceptual model underlying the population health information system (POPULIS).

that such utilization was effective in reducing ill health. The importance of the supply of physicians and hospital beds has since been recognized, as has the role of practice variations: physicians of the same specialty practice medicine in markedly different ways. The role of patient demand—independent of physician supply and practice style—is not as well understood. Furthermore, ill health is not a random event. Biological factors (including genetic predispositions to develop specific diseases), environmental factors (such as pollution), and individual socioeconomic characteristics (poverty, lack of education, unemployment) have a strong negative impact on the health of the population. Although we anticipate eventually incorporating a number of crucial environmental indicators into the information system, we have initially focused on the socioeconomic determinants of health and their relation to utilization, supply, and health status indicators. The impact of social determinants on health is thought to be substantially greater than that of environmental pollutants (Rose 1992), and there is evidence that social determinants are more critical than genetic factors (Horgan 1993). Baird (1994) has argued that whereas the gene pool must be distributed similarly across social classes, individuals in the lower socioeconomic groups usually experience more stressors like poor diet or lack of self-esteem, which in turn trigger more disease in these groups.

POPULIS is population based, designed to track the health status and health care use of populations (regardless of where the usage occurs) (fig. 2). Standardizing the age and sex characteristics of a population across geographic areas adjusts for two of the important determinants of health and use of the health care system. Data on the usual supply elements of health planning (hospital beds, nursing-home beds, and physicians) are presented, but our system also directly measures access, focusing on the proportion of individuals residing in a given area who use a service, regardless of where the service is obtained.

The system is organized around issues relevant for policy makers. For example, questions concerning intensity of use can easily be answered: How much do residents of regions vary in their use of high-tech teaching hospitals versus their use of small rural hospitals for their acute care? What is the relative use across regions of resource-intensive procedures (i.e., hysterectomy versus less intensive procedures like hysteroscopy)? What proportion of residents' care is delivered by specialist physicians rather than by generalists? Do areas with an ample physician supply make less use of acute hospitals? How does the use of health services vary

POPULIS

- Is population based
- Describes
  - supply
  - access to care
  - intensity of use
  - differential use across areas
- Juxtaposes indicators of:
  - socioeconomic risk
  - use
  - health
- Assesses contributions to costs per capita of:
  - differential access
  - dollars per service (visit, day of care)
  - services per user
- Is relevant to system managers
- Sums use across sectors
- Creates regional profiles

FIG. 2. Organizing principles of the Manitoba population health information system (POPULIS).

among regions for individuals who are close to death? We compare usage patterns across regions whose residents have similar levels of good health, allowing policy makers to approach the question of "the right rate" in these terms: "What is the least costly rate associated with good health?"

This system also facilitates comparing discretionary use of services across geographic areas. We have calculated expected length of stay of nursing-home patients based on the age, sex, and level of care at entry to a nursing home (Shapiro and Tate 1988). For example, females aged 65 to 74 years entering at the lowest level of care will stay on average 14.7 years in a nursing home, whereas males 85 years and older entering at the highest level will remain on average 1.8 years. (In Manitoba 95 percent of the individuals entering a nursing home remain there until death.) The degree to which one region admits younger, healthier individuals with a much longer expected length of stay to nursing homes suggests more discretionary use of resources, as does the extent to which

hospitals admit patients for diagnoses whose admission patterns vary markedly across areas (Wennberg, McPherson, and Caper 1984). Similarly, physician visits can be separated into conditions classified as "posing a serious threat to health" versus those classified as less serious.

Costs incurred by a region's residents will be affected by how often residents access a type of care (whether they are admitted to the hospital or contact a physician at least once during the year), the average cost of the service incurred (whether the physician was a specialist or whether the hospital day was spent in a teaching hospital or a small rural institution), and the number of services per user. The interaction of these factors in determining cost per resident is assessed.

Indicators have been selected for their potential value in health care system management. The hospital indicators distinguish among medical, surgical, pediatric, psychiatric, and obstetric admissions, while use taking place in the region of residence can be compared with that occurring outside of it. The physician supply indicators distinguish between physicians available to area residents because they live in the area and those who are effectively available to area residents because patients travel (as do sometimes physicians).

This information system permits adding usage across sectors, using a dollar figure where possible, and, in the case of nursing-home and hospital use, summing total days of chronic institutional care. Finally, profiles of a region showing how its health, socioeconomic risk, and use characteristics differ from the provincial norm can be readily created.

Developing POPULIS

The steps for developing a population-based system to compare health status, various critical risk indicators, and hospital use are straightforward:

1. Create meaningful geographic areas using postal code identifiers that can be linked to census public use tapes. "Meaningful" will vary depending on the purpose of the analyses. To date, we have developed areas based on regions (presented here), physician service areas, procedure-specific hospital service areas (tonsillectomy), and socioeconomic-based neighborhoods for the city of Winnipeg.

2. Obtain data derived from each geographic area for the denominator—the number of area residents as well as their age and sex characteristics (from the most up-to-date census information or from provincial population registries, as available).
3. Obtain indicators of socioeconomic risk for each geographic area (as a first step, use census data to develop indicators like household income, unemployment, education, and cultural diversity).
4. Develop indicators of health status for residents of each geographic area, using various sources, including all-cause, cause-specific, and premature mortality rates from vital statistics files.
5. Describe the utilization of health care by the residents of each area: hospital use; use of nursing homes; use of physician services.

Putting the System Together

Based on the outline of the system shown in figure 2, we will describe its major parts and review the results of the first set of annual reports on care across the regions of Manitoba (fig. 3). We will then illustrate how the population-based approach has been used for needs-based planning for physicians in the province.

Socioeconomic Risk

Systematic relations between socioeconomic characteristics and health status have been observed for roughly 100 years in England and France (Liberatos, Link, and Kelsey 1988); they are currently being rediscovered in North America (Pappas et al. 1993).

Figure 4 shows Thompson residents to be at highest risk for poor socioeconomic status, followed by Norman and Parklands residents. (The socioeconomic risk index is described in the Appendix. It was created from several indicators describing characteristics of neighborhood residents such as unemployment, educational level, and dwelling values.) Residents of the five remaining regions were scored similarly and are at low risk for poor socioeconomic status.

If a region has a more vulnerable population, we expect health to be poorer and the need for health care to be higher (just as if one region had more elderly residents).

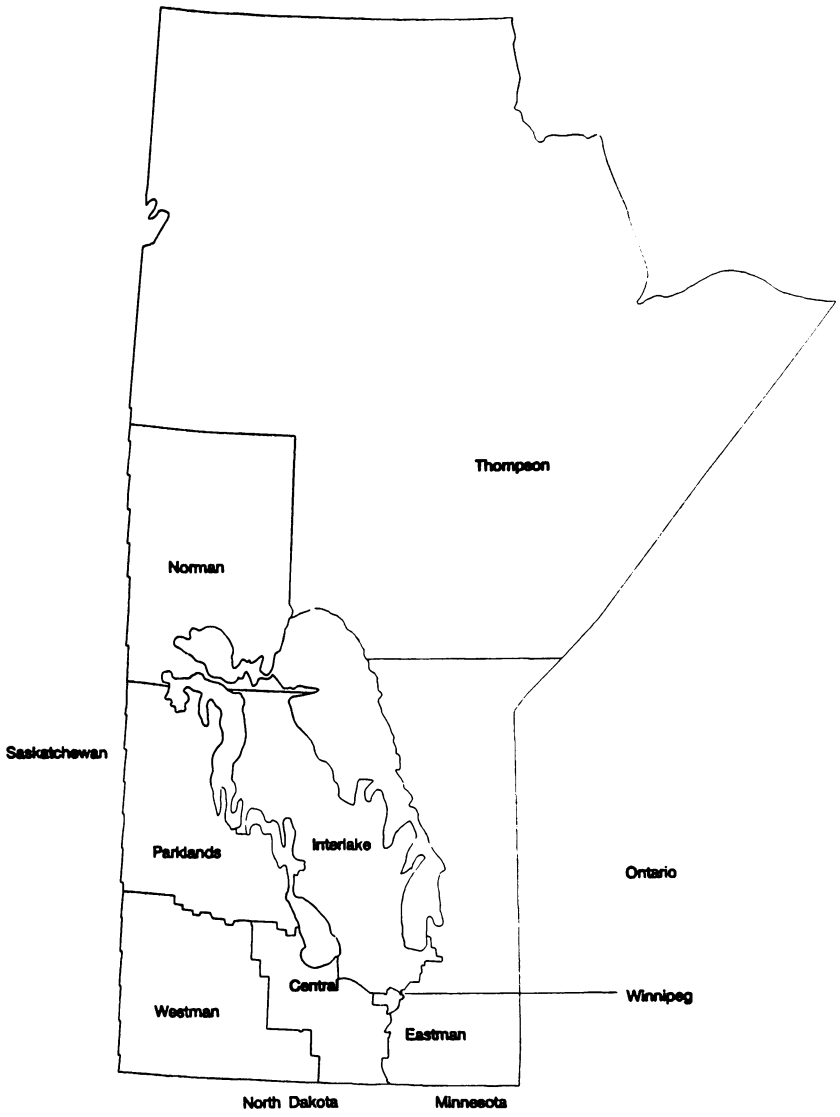

FIG. 3. Regions of Manitoba.

Indicators of Health Status

Currently available instruments to measure health status can be broadly classified according to their focus either on individual health or on the health of populations or communities. POPULIS draws heavily on indi-

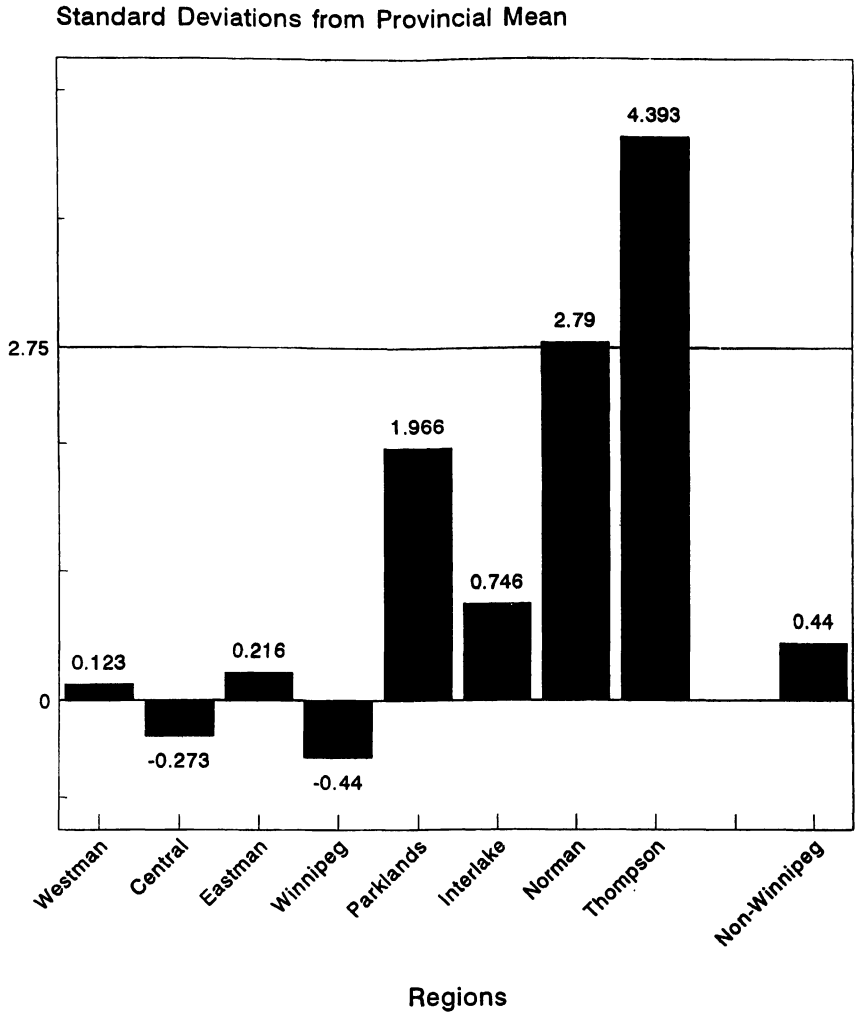

FIG. 4. Regional scores on the socioeconomic index. A high score on the index means poor socioeconomic status (SES) relative to the province. Regions with scores of 2.75 or greater have significantly poorer SES than that of province $\alpha = .05$.

cators developed to measure the health of populations (U.S. Health 2000, Statistics Canada Health Indicators Working Group, for example). Using administrative data to assess health status has a major advantage over surveys, in that the entire population's health status can be assessed repeatedly over time. This proved critical for the physician resource

project described below because some areas in northern Manitoba consist of widely dispersed communities of from 1,000 to 2,500 individuals. Collecting interview-based health status data across the 54 physician service areas would have required a large investment of time and money; the committee responsible for identifying areas of physician undersupply and oversupply required a plan to be in place within six months.

We have developed multiple indicators of health status from administrative data using vital statistics mortality data, hospital discharge diagnoses, and the single diagnosis submitted on claims for physician visits (see Cohen and MacWilliam [1995] for a complete listing). These indicators include aspects of community health like mortality from cancer, injuries, and chronic diseases. The incidence of births under 2500 grams was also obtained from administrative data sources. In addition, we focus on the prevalence of medical conditions (like hypertension) and musculoskeletal conditions (like rheumatoid arthritis) associated with poor functional status and poor self-perceived health (Pope 1988). Another set of indicators relates to treatments, hospitalizations, and deaths that should be avoidable, given timely and appropriate medical intervention or public health action (Charlton et al. 1983; Weissman, Gatsonis, and Epstein 1992).

The standardized mortality ratio (SMR) based on deaths occurring among individuals from birth to age 64 has been suggested as the best single indicator of health status capturing the need for health care (fig. 5) (Carstairs and Morris 1991; Eyles et al. 1993). The SMR for persons from birth to age 64 has been used for allocating health care funds across different parts of Scotland. Norman and Thompson regions show SMRs that are above the provincial average and are much higher than in the rest of Manitoba (fig. 5).

Across the various indicators, residents of the two northern regions (Norman and Thompson) generally show very poor health status, whereas residents of five of the southern regions enjoy good health status. Comparing regional scores on health status with regional scores on the socioeconomic risk index (fig. 4) results in identical rankings. In fact, 87 percent of the variation in health status (measured by the standardized mortality rate for persons from birth to age 64) is explained by differences in the socioeconomic risk index. This relation was observed both at the regional level and across the 54 smaller physician service areas (although for the physician service areas, less of the variation in health status can be explained by differences in the socioeconomic risk index).

Survey data on cardiovascular health in Manitoba (Canadian Heart

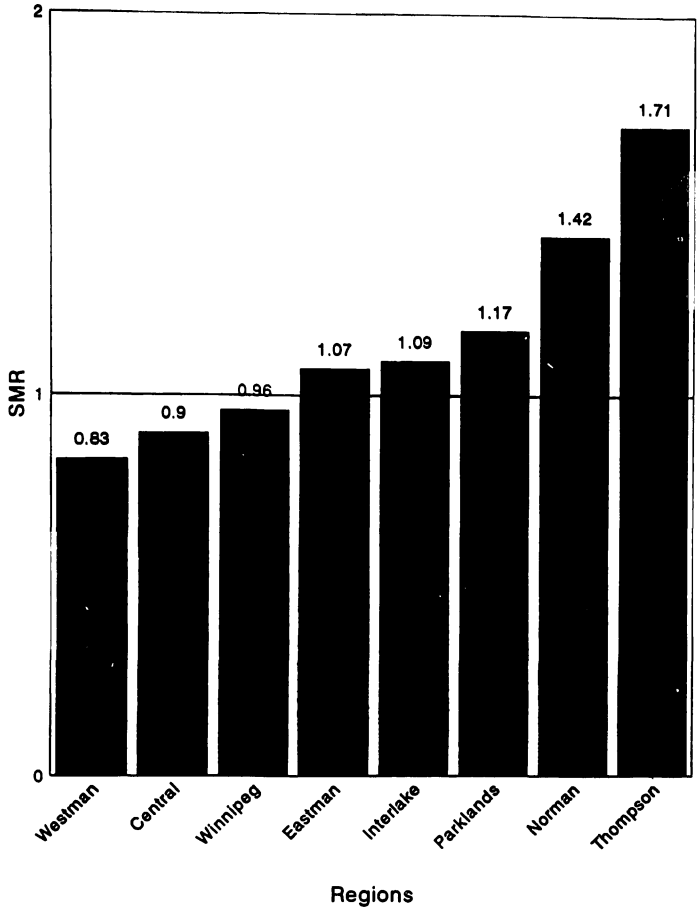

FIG. 5. Standardized mortality ratio for persons from birth to age 64.

Health Surveys Research Group 1992) have confirmed the conclusions on health status drawn from mortality data. The two northern regions are characterized by relatively high proportions of smokers, diabetics, and people who are obese (Gelskey, Young, and MacDonald 1994).

Use of Hospitals

Using POPULIS, the rate of hospitalization for individuals during a given year can be distinguished from the number of hospital discharges per 1,000 residents, the latter being approximately 44 percent higher (table 1). Because patients are sometimes transferred from small rural hospitals to larger centers, episodes of hospital care (where interhospital

TABLE 1
Regional Use of Hospital Resources[a]: Use of Short-Stay[b] Inpatient Care, Fiscal 1991/1992

	Central	Eastman	Interlake	Norman	Parklands	Thompson	Westman	Winnipeg	Non-Winnipeg comparison	Manitoba
Number of residents	94,484	85,180	71,936	24,952	46,056	45,019	117,724	655,055	485,351	1,140,406
Active treatment beds per 1,000 population located in region	4.3	2.4	2.8	7.7	6.8	4.8	6.4	4.9	4.7	4.8
Number of persons hospitalized per 1,000 population	101	98	99	142	123	159	106	75	110	90
Number of episodes of hospital care per 1,000 population[c]	140	139	139	210	184	231	149	99	157	124
Number of hospital discharges per 1,000 population	149	148	148	224	195	263	160	101	168	130
Average length of stay per hospital separation	6.3	6.1	6.4	5.4	6.3	4.4	6.6	7.3	6.1	6.6
Number of days of hospital care per 1,000 population	920	946	938	1,351	1,108	1,532	985	743	1,018	861

[a] All rates (except for average length of stay per hospital separation and bed ratios) are age- and sex-adjusted to the Manitoba population, using an indirect method of standardization.
[b] Defined as stays of from 1 to 59 days.
[c] An episode of hospital care is defined as a continuous period of hospital care that may involve one or more transfers between facilities.

transfers are counted as one episode) are also calculated. In rural Manitoba (the non-Winnipeg regions) patients are admitted to the hospital at much higher rates; the number of hospital days per 1,000 residents per year varies from 743 days per 1,000 Winnipeg residents to 1,532 days per 1,000 Thompson residents. Although residents of the two northern regions have the highest level of socioeconomic risk and the poorest health status, they spend more days in the hospital than residents of any other region. Hospital use across the southern regions of the province also deserves comment: although residents of the five southern regions of the province demonstrated similar health and socioeconomic status, Winnipeg residents spend substantially fewer days in the hospital per capita than do rural residents.

The hospital use module permits replicating table 1 for the following subanalyses:

- where the individual was hospitalized (in-region/out-of-region, Winnipeg/out-of-region, other)
- type of hospital to which the individual was admitted (teaching, community)
- service to which he or she was admitted (surgical, obstetric)
- resource intensity of care received (using diagnosis related group weights)
- complexity of case (whether or not individual had major comorbidities) (Charlson et al. 1987; Romano, Roos, and Jollis 1993)
- discretionary nature of admission (high variation conditions) (Wennberg, McPherson, and Caper 1984)

Nursing-Home Care

Table 2 presents an overview of Manitoba nursing-home use, concentrating on the 85 percent of nursing-home admittees 75 years of age and older. Because new nursing-home beds are opened according to a planning ratio based on 90 beds per 1,000 population aged 70 years or more, existing inequities are historical. Norman has a high per capita rate of nursing-home use. Thompson's apparently low per capita rate is misleading because the availability of a federally funded home (outside the provincial data system) brings the area rate up to the provincial average. Setting aside these two "outlier" regions with very small elderly populations, the availability of nursing-home beds per 1,000 population varies

TABLE 2
Utilization of Personal Care Home Resources by Persons Aged 75+, Fiscal 1991/1992[a]

	Central	Eastman	Interlake	Norman	Parklands	Thompson[b]	Westman	Winnipeg	Non-Winnipeg comparison	Manitoba
Population (age 75+)	6,223	3,826	4,038	811	4,108	497	9,761	36,488	29,264	65,752
PCH beds per 1,000 population	121	118	125	160	122	52	144	128	130	128
Residents of PCH per 1,000 population	130.6	136.2	137.3	161.3	120.0	87.2	142.0	130.8	134.8	132.6
(number)	(834)	(489)	(526)	(115)	(496)	(38)	(1,471)	(4,747)	(3,969)	(8,716)
Admissions to PCH per 1,000 population	28.8	24.4	31.8	26.6	32.2	19.3	27.1	27.1	28.3	27.7
(number)	(183)	(90)	(123)	(20)	(134)	(9)	(277)	(983)	(836)	(1,819)
Days of PCH care per resident of region	37.9	39.6	39.0	48.8	33.0	23.3	41.9	38.2	39.0	38.6
Estimated costs of PCH care per resident of region ($)	2,903	3,081	3,060	3,762	2,495	1,766	3,144	3,018	2,977	3,000
Estimated costs per PCH day ($)	77	78	78	77	76	76	75	79	76	78

[a] Rates are age- and sex-adjusted to the Manitoba population using an indirect method of standardization. All are based solely on the population aged 75 years and older.
[b] Excludes one federally funded nursing home.

only moderately across regions. These supply differences lead to Westman's elderly residents spending approximately 27 percent more days in nursing homes than residents of Parklands; statistical tests confirm much greater variation in hospital use across regions than in use of nursing homes.

Manitoba's centralized assessment procedures to control nursing-home placement also minimize the amount of discretionary use; regions vary relatively little in expected length of stay (as defined above), regardless of the type of home examined (secular/non, proprietary/non). The estimated cost per day of nursing-home care differs only slightly (table 2), from $75 in Westman to $79 for Winnipeg. Such variation in costs per day of nursing-home care is largely influenced by the proportion of residents at each care level. The information system permits replicating table 2 for:

- all ages and age-specific groups
- level of care to which patient is admitted
- type of home

Use of Physician Services

Figure 6 illustrates supply of, access to, and use of physician services across the province. We have included all physician visits except those to hospitalized patients: physician office visits, ambulatory clinic care occurring in hospitals, emergency room visits, physician visits to a patient's home or to nursing-home residents, and all consultations that occur in any of these settings. Although physician availability ranges from 14.6 physicians per 10,000 population in Winnipeg to 5 physicians in Eastman, access to physicians is remarkably uniform across regions; almost 80 percent of the residents in every region contact a physician at least once over the course of the year. Thompson, the region with the lowest proportion of the population in contact with a physician (77.7 percent), receives 50 percent of its primary care from nurses at nursing stations in remote areas. These contacts (and costs) are not reflected in our data. Given that physician supply varies 2.9 times across the regions, the 30 percent range in rate of physician contact (from 4.1 visits per resident in Central to a high of 5.3 per Winnipeg resident) is relatively small. However, 41 percent more per capita was spent on physician contacts for Winnipeggers in 1991–92 than for Central residents ($123 per resident

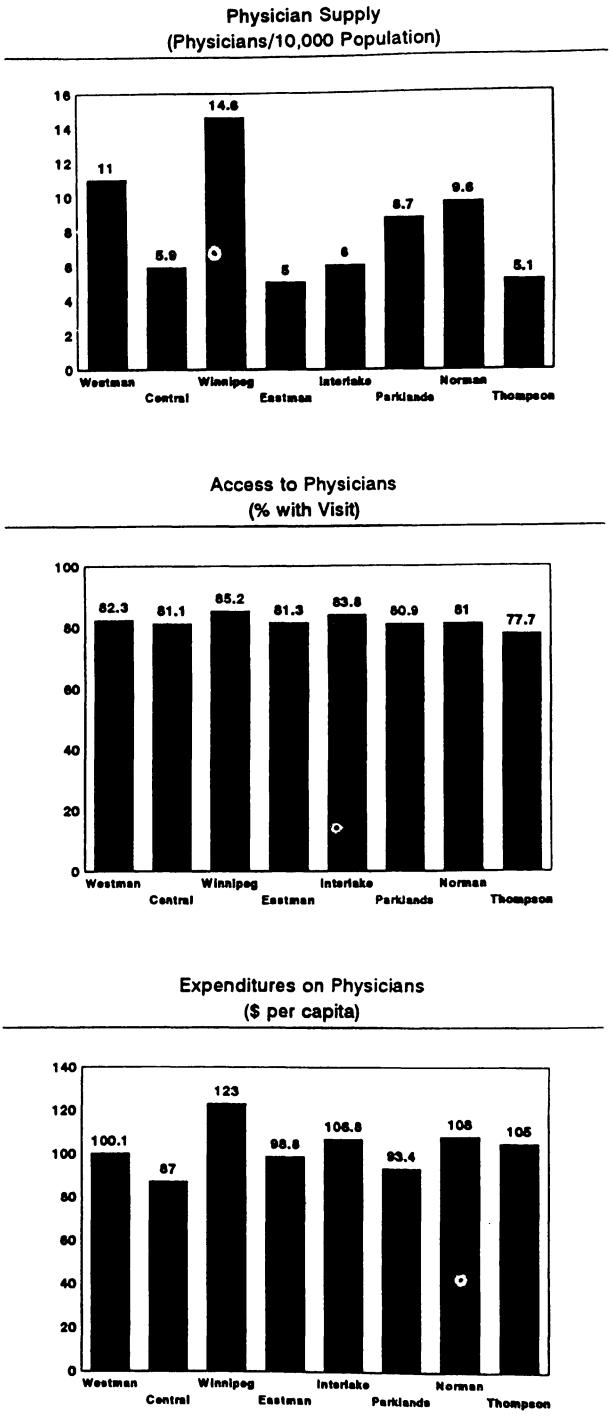

FIG. 6. Physician use across regions.

versus $87 per resident); both visits per user and cost per visit (more Winnipeg care is delivered by medical specialists) are higher in Winnipeg. The three biggest contributors to Winnipeg's high expenditure patterns were visits to psychiatrists, pediatricians, and internists; over a third of the additional expenditures could be traced to psychiatric contact.

Types of Analysis

Demographic Patterns

The population registry permits us to track movement to and from regions of the province by identifying essential characteristics like age and socioeconomic risk status. Although population growth, particularly increases in the numbers of the very young or very old, might be used for planning health services, Carstairs and Morris (1991) have argued that changes in the number of individuals in a population at high socioeconomic risk are at least as important in estimating health care needs. Well-off elderly will have fewer health care needs than those at risk. The system describes demographic changes across geographic areas (migration, births, and deaths) according to the age of individuals and the socioeconomic characteristics of the neighborhood from which residents leave or arrive.

Use across Sectors

Focusing on the number of days that the elderly population of a region spends in a nursing home or in nonacute hospital stays permits an examination of the degree to which the two services substitute for one another across regions. Somewhat unexpectedly, areas (e.g., Westman and Norman) whose residents are among the highest users of hospital beds for nonacute stays (60 days or longer) also tend to be high users of nursing-home resources (fig. 7).

Using Existing Indicators to Assess Hospital Performance

Ministries of health have a special interest in assessing hospital performance. Rural hospitals are a good place to start because indicators for

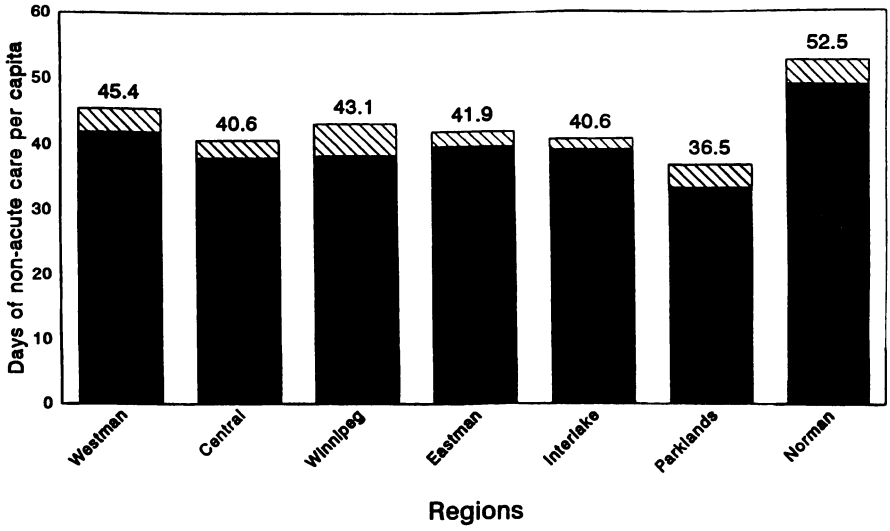

FIG. 7. Use of nursing homes and hospitals by persons aged 75+ for stays of 60+ days (excluding day 1 to day 59). Thompson is excluded from the analysis because of its small number of elderly (497) and because of missing data. Legend: ■, personal care home days; ▨, hospital 60+ days.

these hospitals are generally not contaminated by the referral of patients from outside their catchment areas. Thus, two sets of indicators of hospital performance have been developed:

The first set, based on cases treated by a given hospital, includes the following measures of hospital function:

1. number of people treated
2. neediness of population treated (based on percentage of cases from high-socioeconomic-risk postal codes)
3. case intensity
4. proportion of acute care versus nonacute care (many acute hospitals have long-stay wards)
5. proportion of cases that are surgical
6. cost efficiency for average case treated
7. discharge efficiency (length of stay)
8. outpatient/inpatient surgery ratios
9. occupancy rates

A second set facilitates assessment of hospital performance in relation to the population served, and it includes the following measures:

1. size of the population served (assigning small geographic units to a hospital service area based on a plurality rule of which hospital is used most frequently by area residents)
2. health status of population served (life expectancy, premature mortality)
3. socioeconomic risk characteristics of population served
4. estimated need for hospital services in the hospital service area (based on consideration of age, sex, socioeconomic risk, and health status of population served)
5. use of hospital services by residents of the hospital service area in relation to estimated need

Rural hospitals can be expected to differ on these dimensions. Two hospitals that appear to operate equally efficiently might serve populations of very different health status. Alternatively, hospitals serving populations with the same needs might operate at different levels of efficiency. At a time when major changes are occurring across Canada, the Ministry of Health has recognized the utility of such descriptive data on hospitals.

Longitudinal Research

Tracking indicators over time permits monitoring the direction in which the health care system is moving, changes in the intensity of the care delivered, and changes in health status over time. We recently analyzed four years of data on acute hospital use to assess whether the closure of 16 percent of the beds at the Winnipeg teaching hospitals adversely affected access to hospital services, the quality of care delivered, or the health of the population. We reported that the system adapted very well; we found no decrease in patients treated (largely because outpatient surgical facilities were expanded), no increase in adverse events caused by too early discharge or system cutbacks (as judged by mortality rates, readmission rates, emergency room contacts, and physician office visits within 30 days of discharge). Finally, we observed no adverse impact on the health of the population, even after separate analyses focus-

ing on high-risk groups like the poor and the very elderly (Roos and Shapiro 1995).

Using Population-Based Data for Policy Development

In January of 1994 the Manitoba government and the Manitoba Medical Association (which bargains on behalf of physicians with the province over setting fee-for-service [FFS] payment schedules) agreed on capping the total amount of money to be paid to FFS physicians and restricting the number of billing numbers to be made available to physicians wanting to practice in the province. Without a billing number, a physician has no access to the FFS payment pool and so effectively cannot practice. The Physician Resource Committee was established to develop a comprehensive plan for how many physicians, of what type, are needed in which areas of Manitoba. For the first year, until this plan was in place, new physicians, primarily new medical school graduates, were issued provisional billing numbers with no guarantee of conversion to regular billing numbers.

The Manitoba Centre was asked to be a member organization of the resource committee (along with representatives from the medical association, Manitoba Health, the College of Physicians and Surgeons, the Faculty of Medicine, medical student, intern, and resident associations, and several public representatives). The Centre was also asked to provide analytic support to the committee.

Using POPULIS, we divided the province into 54 physician service delivery areas. We identified area residents according to whether they were in the poorest or the best health, using the premature mortality and low birthweight indicators and noting the areas that were in the highest and lowest quintiles on the measures. The committee viewed socioeconomic risk scores as particularly important, not only in identifying communities at high risk of poor health, but also in specifying communities whose lack of amenities were likely to cause them problems in attracting and keeping physicians.

On the basis of POPULIS, we noted areas that were both well and poorly supplied with physicians. We worked with three measures of physician supply:

1. the relative supply of physicians (full-time equivalent per 1,000 residents) in the area
2. the relative supply effectively available to area residents (Because patients travel, if area A residents used 20 percent of area B physicians, area A was attributed .2 of a full-time employed physician and area B, .8.)
3. area residents' contact rate with physicians (visits per resident) regardless of where the contact took place

A series of map transparencies highlighted the high-need areas (i.e., those in poor health and at high socioeconomic risk) and low-need areas, and the high-supply, low-supply areas. These analyses enabled the committee to identify what they began to refer to as "hot spots," which are the few areas of the province with low supply and high needs.

They also confirmed the high physician supply in Winnipeg. Our earlier analyses (reflected in figs. 4 and 5) had been criticized for treating Winnipeg as one region, masking the relatively large and very poor core area of the city. We divided Winnipeg into eight areas for physician resource planning; the divisions were designed to correspond with socioeconomic neighborhoods. This approach identified Winnipeg's inner core as not only the poorest health area of the province, but also as one whose residents had the highest rate of physician contact, averaging over six visits per resident per year. This provided further confirmation of Winnipeg's ample supply—perhaps oversupply—of physicians.

These analyses helped the deputy minister deal with negative publicity surrounding a supposed exodus of physicians from some rural communities. The population-based data showed that one of the communities from which loud complaints were issuing was both one of the healthiest in the province and well served by physicians.

Because the committee had not finalized its plan by the end of the year, there was strong pressure to grandfather in all physicians given provisional billing numbers. Instead, the committee used the population-based data to argue that only if physicians practiced for at least a four-month period in the North, or for a somewhat longer period in the South outside Winnipeg, would they receive a regular billing number. Physicians remaining in Winnipeg would continue on provisional numbers until the final plan was formulated. Contrary to the frequent press stories about an exodus of physicians from the North and rural areas as

a result of uncertainty about the new process, a comparison of the six-month periods before and after the plan instead revealed a desirable increase in physicians in the North and rural South, accompanied by a decrease in the Winnipeg physician supply.

Discussion

This information system has evolved through close interaction of the Manitoba Centre staff with government managers and policy makers. Developing data for use by policy makers requires great attention to detail: stakeholders will challenge aspects that do not support preconceptions. The tendency to produce volumes of indicators and cross-tabulations must be balanced by the commitment to produce timely information. More detailed analyses do have a clientele. Manitoba Health's capital planning group and Centre investigators have conducted population-based analyses for ten rural hospital service areas interested in "repatriating" care to rural hospitals that is currently delivered in urban centers. Manitoba Health can either request these analyses on a one-time basis or develop its own internal capabilities for implementing the analytical programs once the basic system is designed. Over time, analyses are being used to assess the impact of major health reform initiatives; a separate module focusing on the use of mental health services across the province has been developed.

What conclusions can be drawn to date? First, the Canadian system, which provides first-dollar coverage of health use for hospitals, nursing homes, home care, and physician services, appears to be partially needs driven and to work reasonably equitably in Manitoba. The two regions whose residents have the highest levels of hospital use (the northern, geographically isolated Thompson and Norman regions) are also those whose residents have the poorest health and the highest scores on the socioeconomic risk index.

Thompson residents are hospitalized frequently despite having a merely average availability of hospital beds and the most limited physician supply of any region. However, as fully 30 percent of their hospitalizations occur in other regions, they would not seem to be supply driven. On the other hand, although much of its high use may be related to need, Norman has both more hospital beds per capita than any other region and a rich supply of physicians (8.9 physicians per 10,000 popula-

tion versus 6.9 in rural Manitoba more generally). Future analyses will try to separate the proportion of use that is apparently needs driven from that associated with supply and/or practice patterns.

The health of the population should be the cornerstone for challenging and improving health care. Although health status measurement may be imperfect, the indicators used in this system clearly pick up marked health differences across Manitoba's regions. Large, consistent differences across a wide variety of measures document the poor health status among Thompson and Norman residents. The strong, statistically significant differences in mortality rates across Manitoba regions can be compared with the failure of many popular and expensive medical therapies to show a positive impact on reducing the population's mortality rate. Cholesterol lowering, screening for prostate cancer, and breast-screening mammography have not been shown to reduce overall mortality in a population (Russouw, Lewis, and Rifkind 1990; Holme 1990; Krahn et al. 1994; Schmidt 1990). (There appear to be no data to date demonstrating an impact of breast-screening mammography on overall mortality. Thus, screened women "saved" from dying of breast cancer seem to die just as early as unscreened women—but of another cause.) Future analyses will systematically attempt to estimate the strength of the relations among risk factors, health status, supply, and practice patterns outlined in figure 1.

Clearly, the health care system is supposed to care for those who are ill, and Manitoba provides a remarkably high level of care for residents of disadvantaged regions. However, given the strong relation between socioeconomic risk factors and health status and usage, what is the most effective way to ensure access to health? High use of the health care system does not guarantee health. Ongoing longitudinal analyses will help sort out the extent to which high health care expenditures over time are associated with improving population health. However, current expenditure patterns both pose the danger of driving out the ability to fund other programs and appear unlikely to resolve the underlying problems that create poor health. Although the health problems of Norman and Thompson residents should not be ignored, our analyses raise fundamental questions about the part played by the health care system in improving the health of the population.

In the United States and Canada, much effort has been expended on fine-tuning the existing system by developing practice guidelines for physicians and by improving the efficiency of hospital treatment. The

Physician Payment Review Commission (1994) articulated a national data strategy that is not population based and that ignores the main data elements necessary to refocus health policy on the determinants of health: health status, socioeconomic status, and health care use. Instead, the commission details the principal requirements of a national data strategy for health system reform:

1. monitoring utilization and costs
2. monitoring quality of care
3. establishing accountability for quality and access
4. supporting outcomes research
5. profiling and measuring risk

Such a national data strategy neither leads toward a focus on the health of populations nor facilitates a consideration of the link between use, expenditures, and health. The flagship publication of the National Center for Health Statistics, *Health United States*, in 1993 provided population-based data by state on health status measures, health care use, and socioeconomic status (at least to the extent that race serves as a proxy), but the data were presented independently, with no attempt to identify relations across these elements. Population-based analyses are not new to the United States; Wennberg and Gittelsohn's (1973, 1982) small area analysis demonstrating marked differences in treatment patterns across neighboring communities led directly to the focus on outcomes assessment and to the Patient Outcomes Research Teams (PORTs) (see Wennberg 1990). Although the original design of this effort included a strong population focus, administrative data effective at the population level have not captured subtle clinical differences and hence are rejected by clinical researchers. Research capable of addressing population health issues appears to have been deemphasized.

The strengths of population-based information are more obvious in a single-payer system. To the extent that health maintenance organizations and the Veterans Administration serve populations and act as single payers, they should also benefit from this approach. In targeting and monitoring expenditure/use patterns, health status and socioeconomic risk are crucial factors.

The role of the health care system as a determinant of health has been overemphasized. To improve the health of the population, resources

must be reallocated from health care to more directly preventive activities. But where do we target these funds? Into social policy to improve standards of living? (Sewage treatment and better housing on native reserves is a long unanswered call.) Into education—particularly early childhood education—in an attempt to raise more effective adults? Into private sector efforts to create meaningful jobs so that families can become more functionally viable? Now is clearly the time for more fundamental and applied research on the determinants of health from a broad social policy perspective. Needed funds can come at least partially from basic biomedical research, which has historically been much better funded than work directed toward the social determinants of health.

The type of analyses presented here can be of considerable use to policy makers. Our research, and our work on population health generally, seems to have encouraged some new thinking in Manitoba. Funds from the Manitoba health budget have been used to support interdepartmental planning among the ministries of health, education, justice, and family services (which provides welfare) for an initiative on single mothers. This followed a Centre study suggesting that socioeconomic differences in birthweight are primarily attributable to factors other than use of early prenatal medical care (Mustard and Roos 1994). A broadened information system will permit the health outcomes of this initiative to be monitored.

Finally, this approach offers policy makers and the public the ability to separate issues of health from other factors. By directly measuring socioeconomic risk status and demonstrating its strong link to population health, an independent set of social levers outside the health care system is identified. Unfortunately, the growing literature suggestive of what these policy initiatives might be is not central to health services research. Grantham-McGregor and colleagues (1991) compare nutritional supplementation, psychosocial stimulation, and mental development of stunted children. The World Bank (1993) suggests investing in maternal education as a means of improving children's health. The Perry Preschool Study (Weikart 1989) demonstrated that inner-city children who were randomly assigned to a "preschool" group received major long-term benefits compared to their contemporaries not receiving the "treatment." Nineteen years later the preschool group had higher rates of school graduation and college attendance, fewer arrests, fewer teenage pregnancies, higher rates of employment, and a lower reliance on wel-

fare. Although health measures per se were unavailable for the two groups, the strong association between socioeconomic status and health strongly suggests the health benefits of such a program.

Such initiatives and an appropriate information base are important for breaking the cycle of the "medicalization of social ills" (Hurowitz 1993). A change of paradigm threatens many entrenched interests but suggests a path toward both improved health and a better society.

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Appendix

Using Census data gathered and published by Statistics Canada, we obtained a variety of measures of socioeconomic status for residents in each

of the eight regions. A set of five poor health and usage indicators deemed to be particularly sensitive to differences in socioeconomic status was used to construct a test index against which to measure the explanatory power of candidate socioeconomic indicators. The socioeconomic measures most highly associated with our health status index were the percentage of the population between the ages of 25 and 34 who had graduated from high school; the percentage of the labor force between ages 15 and 24 and between ages 45 and 54 who were unemployed; the percentage of single-parent, female-headed households; the percentage of females participating in the labor force; and the average dwelling value. The indicators used in the test health status index included the admission rate to hospitals of females for injuries; the admission to hospitals of males for injuries; the admission to hospitals of children from birth to age four for respiratory infections; the admission to hospitals of persons greater than age 65 years for respiratory infection; and fertility rates. Removing fertility from the test index—in response to observations that it was not a measure of "poor health"—led to similar results. The indicators were weighted on the basis of the strength of their association with the health status index.